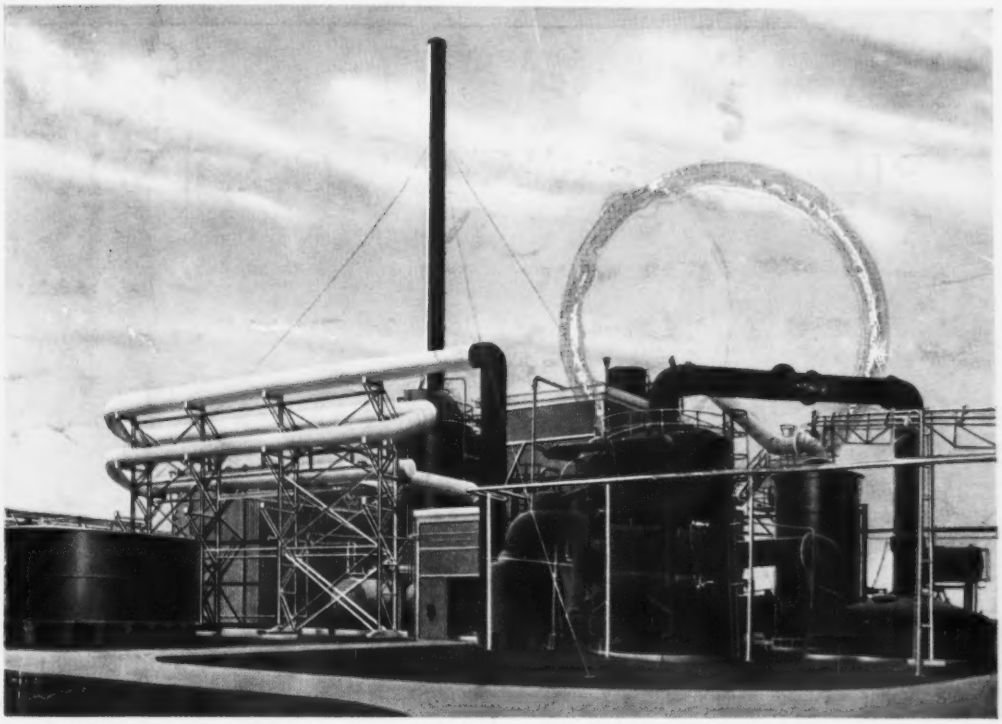

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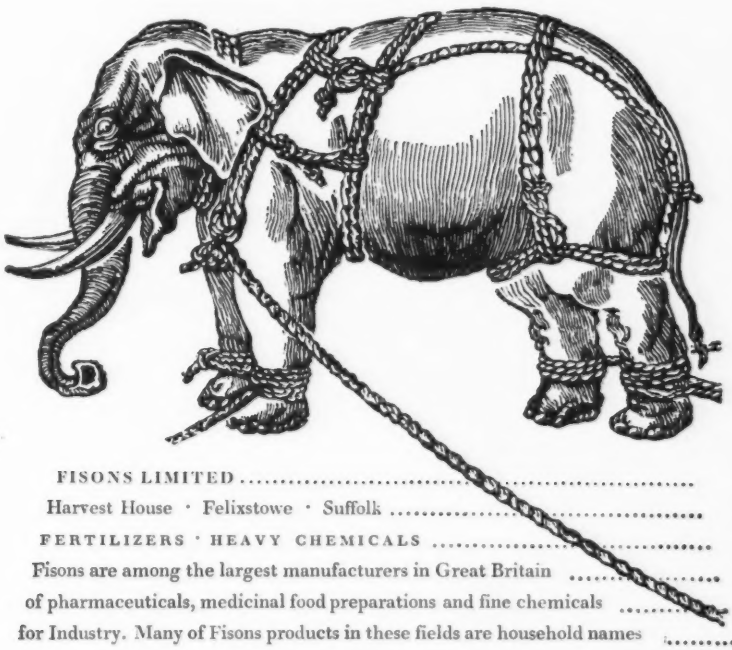

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DECEMBER 1955

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FOREWORD

THIS ELEVENTH ISSUE of the *Bulletin* completes a full year of publication in the improved, printed form. Undoubtedly the venture has been a success judged by the many expressions of appreciation that we have received and by the encouraging number of new subscribers.

We would like to take this opportunity to thank our subscribers, old and new, for the support and encouragement they have given us. Our publication date is too late for us to convey our Christmas greetings to our readers, but we do wish you, one and all, success and prosperity for 1956.

December, 1955.

Review

Trends in World Sulphur Trade and Sulphur Freights are examined in the light of new developments against the background of the changes in the movement and the pattern of consumption of sulphur during the past half-century. The principal new factors are the emergence of Mexico as a major source of supply, Italy's decision to re-enter export markets with competitive supplies, and the effect of the unprecedented coal situation in the U.K. and in Western Europe on sulphur and pyrites shipping space and freight rates. Although the size and the fluctuation of the U.S. domestic market remains a powerful factor, in particular as an outlet for a substantial proportion of the new Mexican supplies, the focus of the export trade in sulphurous raw materials is the U.K. and Western Europe, where the new developments are hardening the trend of declining pyrites usage. The threatened relative increase in pyrites freights from the Western Mediterranean, if not balanced by a substantial reduction in the f.o.b. price, is expected to accelerate this trend as the increasing use of indigenous resources, mainly in the form of recovered sulphur and anhydrite, are narrowing the market and causing the rising elemental sulphur supplies to exert growing pressure.

The production and practically the entire consumption of sulphur in the **Belgian Congo** are integral and essential features of the various mining and metallurgical operations of the Union Minière du Haut Katanga. Of about 130,000 tons sulphur contained in copper and zinc sulphide ores, at present less than one-fifth is recovered from zinc smelter gases as sulphuric acid, a slightly greater tonnage is exported in zinc concentrates, and the balance, in the form of sulphur dioxide, present in exit gases from the copper smelter, is exhausted to the atmosphere. The present level of acid production of about 65,000 tons (100% H_2SO_4) is expected to be nearly doubled over the next two years to meet rising requirements for copper, cobalt, zinc calcine and uranium ore leaching and base metal electrolysis.

The projected application of sulphating roasting of mixed base metal ores promises both a saving of existing acid supplies and the recovery of acid by the electrolysis of the metal sulphates. Pending the developments of other sulphur or sulphuric acid using industries, notably fertiliser manufacture, in the Belgian

Congo, the level of annual consumption equal to about 40,000 tons sulphur to be reached in about two years, is unlikely to be exceeded.

In the **United States** production of Frasch sulphur during the third quarter of 1955 of 1,486,934 tons, exceeded the previous quarterly peak output by over 100,000 tons. In consequence production of native and recovered sulphur during the first nine months, at an annual rate 5.85 million tons, attained virtually the same level as that in 1954. The continued high level of industrial activity, boosting sulphuric acid needs—notably of the steel, detergent, rayon, and oil industries—and sulphur requirements for rayon and pulp manufacture, resulted in apparent sales during the first nine months at an annual rate of 6.15 million tons. Exports during this period were similar to those in 1954, but domestic consumption showed an increase of over 10%, and in view of rising demand in the last quarter the end of year results are expected to exceed 1954 usage by 12-15%. In the third quarter stocks of Frasch and recovered sulphur increased by 108,400 tons, but at the end of September they were still 230,000 tons smaller than at the beginning of the year. Continued production at peak levels and rising imports from Mexico—the first substantial foreign contribution to domestic sulphur needs since before World War I—should halt the further deterioration in producers' stocks.

In **Italy** the decision of the Government to supplement financial aid to producers with a subsidy to the Ente Zolfi Italiani to permit the disposal of the sulphur stockpile, has led to the resumption of exports, which in the third quarter amounted to about 13,000 tons, the highest level since the end of 1952. Production in 1955 is expected to total about 230,000 tons, as the result of the increased rate of output of about 67,000 during the third quarter. An increasing proportion of this originates from the few modernised plants, and the Central and the Regional Sicilian Governments hope that the measures, recently enacted in law, will lead to more producers taking advantage of the financial and technical provisions of the long-standing programme of re-equipment to bring about more economic overall production.

Current output of Frasch sulphur in **Mexico,** one year after the steaming of the first dome outside the U.S.A., ranges up to 2,500 tons a day. In addition to the projected expansion at the two domes which are at present being exploited by the Mexican Gulf and Pan American Sulphur Companies, two further domes, Las Salinas and Santa Anita, are to be steamed early in the New Year by the Gulf Sulphur Corporation and Texas Gulf Sulphur Company respectively. Simultaneously, the state oil industry, Petroleos Mexicanos (Pemex) is giving effect to important plans for the installation of new plant capacity for the recovery of sulphur from natural and oil refinery gases.

The sulphur industry is growing rapidly and new projects hold promise of about 900,000 tons elemental sulphur being produced in 1956 and over 1½ million tons in 1957. Exports in 1955 are expected to total 230,000 tons. The home market, primarily supplied by Pemex, should take up about 35,000 tons and its expansion, aided by foreign investment capital, is likely to be rapid, rising to 150,000 tons by 1957. Disposing of the vast export surplus will present, at least for the time being, a major problem.

In **Japan** consumption of elemental sulphur has in recent months exceeded producers' ability to meet requirements, and the Government has been obliged to authorise imports. At the same time the modernisation plans of the Matsuo Mining Company reached a decisive stage when operation of a pilot plant, which embodies a new furnace design, fulfilled expectations, and it was decided to replace the entire existing and obsolete installation by new plant capable of producing 6,000 tons refined sulphur per month by 1957. The supply crisis in one of Japan's principal indigenous raw materials has focussed renewed attention on the widely practised uneconomic methods of sulphur production, and prompted a vigorous examination of measures to bring about the greater rationalisation of the industry.

In the **United Kingdom** consumption of sulphur in various forms during the third quarter 1955 amounted to 203,000 tons.

Although not strictly comparable with other periods as the particulars of the new anhydrite acid plant of Solway Chemicals Limited at Whitehaven, which started operating at half capacity early in July, are not included in the above total, this was 1% greater than consumption in the corresponding period of 1954. Substantially increased anhydrite usage at existing plants raised consumption of indigenous raw materials to 40% and the proportion of anhydrite acid to 14¼%, the highest levels yet recorded. The main impact of the additional anhydrite acid supplies was felt by users of spent oxide and pyrites, and the usage of both raw materials contracted sharply. Acid sulphur maintained its relative position, but the actual tonnage used for acid manufacture and also that for regular purposes receded seasonally. Production of sulphuric acid of 490,700 tons (100% H_2SO_4) and consumption of 489,600 tons were fractionally higher than during the corresponding period of 1954.

As anticipated, the Government controls of imports of brimstone and of its use in sulphuric acid manufacture were rescinded on 18th October with effect from 1st January 1956. In view of the probable displacement of some brimstone acid supplies by the abundant output of anhydrite acid, no significant changes in brimstone use are likely to become apparent pending the natural growth of overall acid requirements. Whereas no further significant inroads into spent oxide usage are likely to occur due to the relatively favourable price of sulphur in this form, the consumption of pyrites in the U.K. is expected to decline considerably. The new pattern of sulphur consumption should manifest itself towards the latter half of 1956, when a high level of anhydrite use and an increasing rate of brimstone consumption are likely to be the outstanding features.

Whilst the domestic and export **prices** of U.S. sulphur, which still accounts for about 92% of world trade, have remained stable, the increasing volume of export sales of Mexican Frasch sulphur at prices now up to $4.50 below those of comparable U.S. grades, point to the emergence of a two-price structure in world markets. Landed costs of Chilean sulphur and of subsidised Italian sulphur in selected markets, where it enjoys a freight advantage, now appear to be related to the Mexican quotations. The price of European pyrites is expected to remain unchanged for at least the first six months of 1956, in spite of considerable pressure for a reduction and the overt signs of its worsening share of the sulphur market.

World supplies of elemental sulphur are at present increasing at a rate much exceeding the natural growth of markets. The high level industrial activity throughout the world, but especially in the U.S.A., has not so far caused any difficulties to producers in the U.S.A. in the disposal of their recent record output nor is the accumulation of the stockpile of Mexican sulphur anything but desirable. The imminent further expansion of Mexican supplies is expected to present a major problem, as competitive supplies from Italy and Chile and increasing use of indigenous resources, mainly in the form of recovered sulphur and anhydrite, are narrowing the market. Growing non-acid sulphur needs for pulp and rayon manufacture, and to a lesser extent for agricultural use, are expected to increase the demand for bright sulphur. Added to this there is a substantial volume of brimstone acid plant construction in progress throughout the world. Ample supplies of all grades promise to ensure the maintenance of a competitive supply position.

TRENDS IN WORLD SULPHUR TRADE AND SULPHUR FREIGHTS

General

ONE year ago — in Bulletin No. 7 — the adequacy of world sulphur supplies was reviewed and the conclusion that elemental sulphur supplies over the coming 10-12 years would expand at current price levels to meet the growing requirements of sulphur in this form has been strengthened by events. A number of these developments, however, prompt a further examination of future trends of the movement and the pattern of consumption of sulphur in its various forms. The principal new factors which may further alter the pattern of consumption that has evolved over the past half century are the emergence of Mexico as an assured major source of supply, Italy's decision to terminate a period of ineffective expectancy of a renewed sulphur price boom and the effect of the unprecedented coal supply position in the U.K. and in Western Europe on sulphur and pyrites shipping space and freight rates.

increase in sulphur consumption may temporarily mask such periods of transition without, however, affecting the new trend in either consumption or trade. The most potent influences in the past half century were the production, prior to World War I, of low-cost elemental sulphur in the U.S. Gulf area, and 20 years later the increasing application of sulphur recovery from natural and industrial gas and the large-scale use of sulphur in anhydrite (see fig. 1). While total consumption between 1914 and 1934 increased $1\frac{3}{4}$ times, the use of Frasch sulphur in this period rose nearly fivefold and sulphur in pyrites, formerly the dominant source of supply, only increased by one-third. Between 1934 and 1954, while total usage more than doubled, Frasch sulphur use increased nearly $3\frac{1}{2}$ times, the use of recovered sulphur and sulphur in other forms threefold and pyrites by only one-half.

Consumption of:	*1914* Mill. Tons	%	*1934* Mill. Tons	%	*1954* Mill. Tons	%
Frasch Sulphur	0.34	9.7	1.61	26.4	5.42	41.1
Recovered sulphur	—	—	.11	1.8	0.71	5.4
Rock sulphur	0.46	13.1	.54	8.8	0.45	3.4
Elemental sulphur	0.80	22.8	2.26	37.0	6.58	49.9
Sulphur in Pyrites	2.42	68.7	3.16	51.7	4.93	37.3
Sulphur in other forms	0.3	8.5	0.69	11.3	1.69	12.8
Total	3.52	100.0	6.11	100.0	13.20	100.0

World Trade

The abundance and variety of sulphur resources has caused, ever since its large-scale use as a basic industrial raw material, a relative rapid change in the world pattern of consumption following the emergence of new and more economic sources of supply in one or other form. In this, sulphur being a low-priced commodity, the cost of transport from sources of supply to major consuming centres remains a dominant factor. The absolute

In spite of the large increase in total usage, the volume of international sulphur trade remained practically unchanged between 1914 and 1934 and since then has risen by just over one-third.

In view of the decreasing share of pyrites in world sulphur trade the tonnage actually moved, which in 1914 amounted to about 4 million tons, increased to only $4\frac{1}{4}$ million tons in 1934 and a little over 5 million tons in 1954.

World trade	*1914* Mill. Tons	%	*1934* Mill. Tons	%	*1954* Mill. Tons	%
Elemental sulphur	0.43	20	0.85	35	1.80	54
Sulphur in pyrites	1.68	80	1.60	65	1.54	46
	2.11		2.45		3.34	

The increased consumption of indigenous sulphur supplies is partly attributable to the substantial growth of the U.S. and Japanese markets, but as shown below since 1934 it is to a large extent occasioned by the increased use of resources other than native sulphur and pyrites.

The focus of sulphur movement remains the U.K. and Western Europe, while the principal source of supply has changed from Europe, notably Spain, to U.S.A. Against this background the advent of Mexico as a further transatlantic source of elemental sulphur in quantities far exceeding the expected natural growth of markets in the next two years cannot fail to influence the pattern of consumption, as, moreover, the facilities for moving pyrites are at a critical stage.

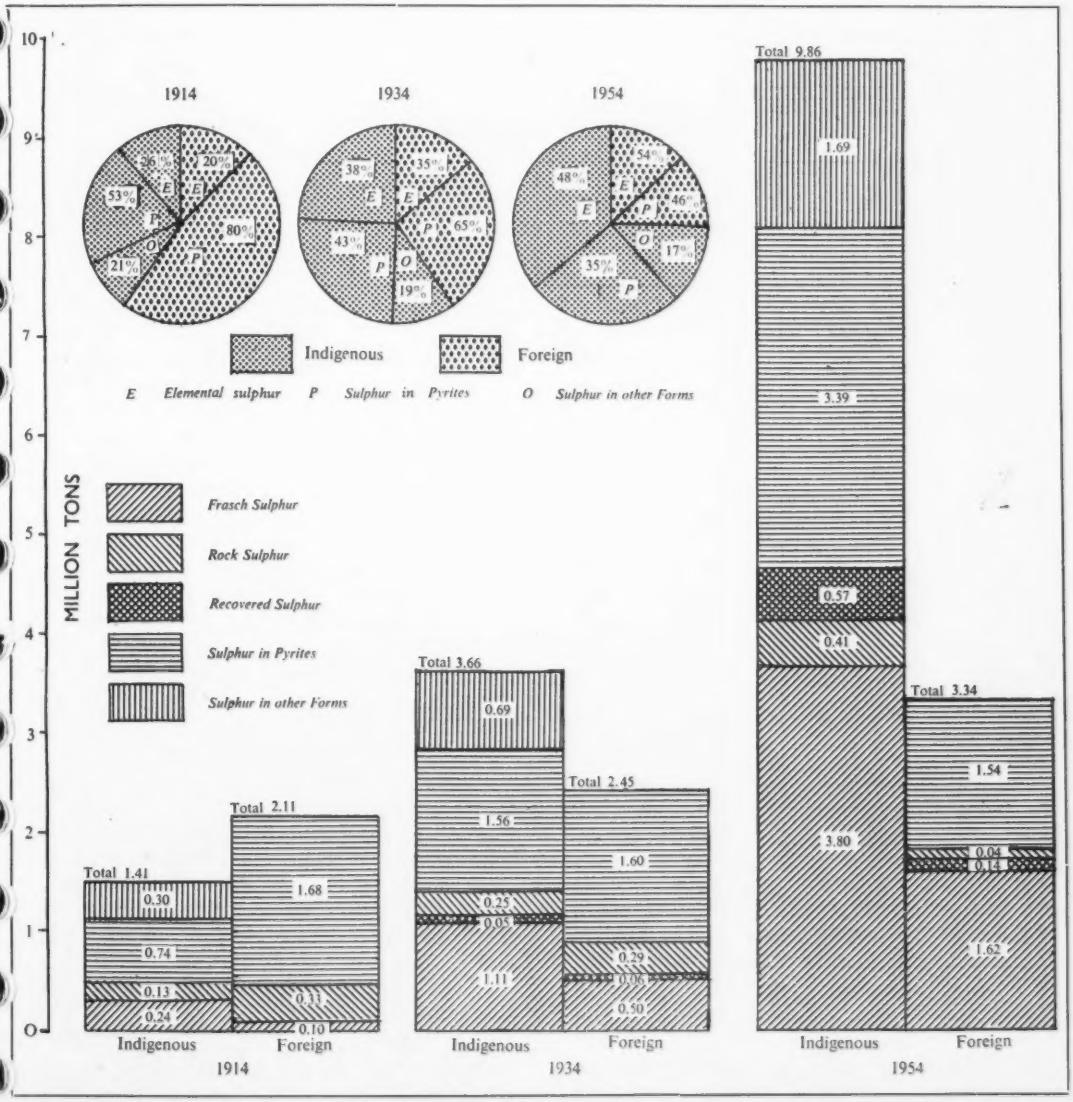


Fig. 1. World Consumption of Sulphur. Distribution of use of indigenous and foreign supplies in various forms.

Shipping Space and Freight Rates

Of the total tonnage of sulphur in pyrites which entered world trade in 1954 about 85% originated in the Mediterranean region and of this, more than two-thirds were shipped from Portugal and Spain, the latter still being the second largest sulphur exporting country in the world.

The developments in shipping facilities referred to below do not to any great extent affect the Eastern Mediterranean, notably Cyprus, which is well served by liner and passing tramp shipping facilities.

The Western Mediterranean trade, however, which in addition to pyrites, is based on the movement of North African Phosphate and Iron Ore, has hitherto been a specialised sector closely linked with the outward movement of coal from the U.K. and the Continent. Thus freight rates, for this traffic, although influenced by the rise and fall of the freight market in general, have tended to remain moderate. In recent years freight rates to Continental ports, by comparison with U.K. destinations, have been particularly favoured due to their better turn-round facilities.

The virtual cessation of coal exports from the United Kingdom and from Western Europe and the simultaneous large-scale movement of coal across the North Atlantic are having the dual effect of depriving ship-owners of profitable outward voyages to the Western Mediterranean and of attracting many of the more modern vessels to the lucrative North Atlantic business. This development is aggravated by the fact that practically all the vessels left in the pyrites trade, in particular those of 3,000/4,000 tons carrying capacity, were built prior to 1920, and are not only insufficient to maintain the present rate of shipments but are on the point of having to be replaced. Such a replacement by modern large size vessels — possibly specialised ore carriers — would inevitably result in a higher level of freight rates. The following table gives an indication of the changes in the level of pyrites freights from Huelva to Rotterdam and of sulphur freights from the U.S. Gulf to the United Kingdom ports:—

	1951	*1952*	*1953*	*1954*	*1955*
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*
PYRITES					
High	60/9	50/7½	26/-	33/6	36/-
Low	42/6	23/9	23/3	25/-	34/9
SULPHUR					
High	150/-	120/-	52/6	80/-	100/-
Low	112/6	37/6	45/-	46/-	82/6
U. K. CHAMBER OF SHIPPING overall index of tramp freights	*157.1*	*100*	*77.5*	*86.1*	*130* (approx.)

North Atlantic freights, which by October/November had risen under the impetus of coal charters sufficiently to enable even U.S. tramps to engage competitively, have receded to a level which entails a sulphur freight from the Gulf to Europe of about 90 shillings, i.e. about 30s. above the rate from Hampton Roads. In the immediate future, due to world-wide demand for shipping space, the rate from the Gulf is expected to harden at a level of about 100s. It is probable after March/April that this may ease, but it is doubtful whether with seasonal shipping requirements for West Indies sugar and U.S. grain it will recede below 75s. At this level the cost of shipping augments the f.o.b. cost of Mexican sulphur by about 40% while at an anticipated pyrites freight level from the Western Mediterranean of 65s., the present day cost of sulphur in pyrites, on an all values basis, would be increased by 61%. Assuming a net residues value of £2 per ton of pyrites, the shipping cost would double the prime cost of sulphur and result in a landed cost greater than that of Mexican sulphur.

The principal changes caused by the coal situation are without precedent and in consequence not precisely predictable. Indications, however, point to the adverse phase for the pyrites trade reaching its climax by about 1960, and persisting until the wider application of

atomic power after 1965 and the probable termination of the need for large-scale coal movement will once more radically change the general shipping picture.

Conclusion

Although the sulphur crisis of 1951/2 boosted the use of pyrites, the economic advantages of brimstone having been temporarily eclipsed by the fear of failure of supply, present increasing availability of low cost elemental sulphur, coupled with the imminent rise in the cost of shipping pyrites, threatens to cause a serious decline in pyrites usage, a development which was obscured during the period of instability—if not panic—four years ago. Pyrites users, now considering plant replacement, are faced with an unequivocal choice in view of the pressure of these competitive supplies of elemental sulphur from the U.S.A., Mexico, and once more from Italy. They include acid makers in the U.K. and Eire, and those on the Continent who have experienced or fear difficulties in disposing profitably of their residues. The pyrites users to whom brimstone usage does not offer any present advantage are the Germans and a limited number of other continential users who ship their requirements at relatively low freight rates and derive the most benefit from residue sales. The probable rise of these favourable freight rates after mid-1956 is expected to lead, even amongst them, to the examination of partial substitution, which in the case of most chamber acid installations could be effected by plant modifications at relatively low cost.

In spite of the overt advantages of brimstone use, it would be unrealistic to expect a rapid displacement of pyrites, in the face of industrial tradition and caution in respect of potentially favourable but not absolutely essential projects requiring substantial capital investment. In 1956 an absolute reduction in the world-wide use of non-indigenous pyrites of about 100,000 tons sulphur content is expected; thereafter, failing a substantial adjustment in the price relation between brimstone and pyrites, the decline of their share of the world market cannot fail to accelerate.

BELGIAN CONGO

General

ALTHOUGH, like most of Africa, the Belgian Congo lacks deposits of native sulphur, the exploitation of the vast deposits of non-ferrous sulphide minerals has led to the recovery of sulphur in the course of metallurgical operations and its essential use in the form of sulphuric acid in the treatment of ores.

The development of the Belgian Congo to its present-day position as one of the leading world producers of copper, cobalt, tin, zinc and uranium can be identified with the growth of the *Union Minière du Haut Katanga*, which was formed in 1906 by the joint interests of Tanganyika Concession Limited of London and the Societé Générale de Belgique of Brussels. Under the direction of the present chairman of the company, Mons. E. Sengier, its activities have exerted an unprecedented influence on the social and industrial development of the country.

The present-day structure of this powerful group of industries owes its origin to the far-sightedness of King Leopold II which, in the early stages of the company's existence, found expression in the activities of Jean Jadot, Sir Robert Williams and Emile Francqui, whom the present chairman succeeded.

The expansion of metal mining and smelting activities was necessarily, on account of the geographical isolation, accompanied by the establishment of ancillary industries, including generation and transmission of hydro-electric power and the manufacture of cement explosives and chemical products, under the control of subsidiary companies. The chemical activities are conducted by the *Societé Générale Industrielle et Chimique du Katanga*, who make use of the sulphur-dioxide content in the zinc smelter gases to produce sulphuric acid. Present plant capacity is equivalent to the use of 35,000 tons sulphur annually and under existing expansion plans this is to be raised by about 10% in the near future. Actual acid output in 1954 represented the use of about 25,000 tons sulphur which accounted for about one-fifth of potential sulphur supplies. Exports in the form of crude blende accounted for about

30,000 tons sulphur while the balance, represented by sulphur released in the smelting of sulphide copper concentrates, was exhausted into the atmosphere.

Apart from the integrated sulphur/sulphuric acid operations of the Union Minière du Haut Katanga the sulphur requirements of the Belgian Congo are negligible. Amounting to about 100 tons annually, they are met by imports mainly from U.S.A. and Belgium of ground and special grades of sulphur. The metals as well as deposits of uranium and radium.

The copper deposits contain mostly oxide ore but some, notably at depth, contain copper sulphides in the form of bornite, chalcopyrite and chalcocite, and also mixed oxide-sulphide ores. The principal sulphide ore mine is Kipushi (Prince Leopold) where copper ores are closely associated with zinc blende.

Separation is effected by differential flotation at the adjacent Kipushi concentrator

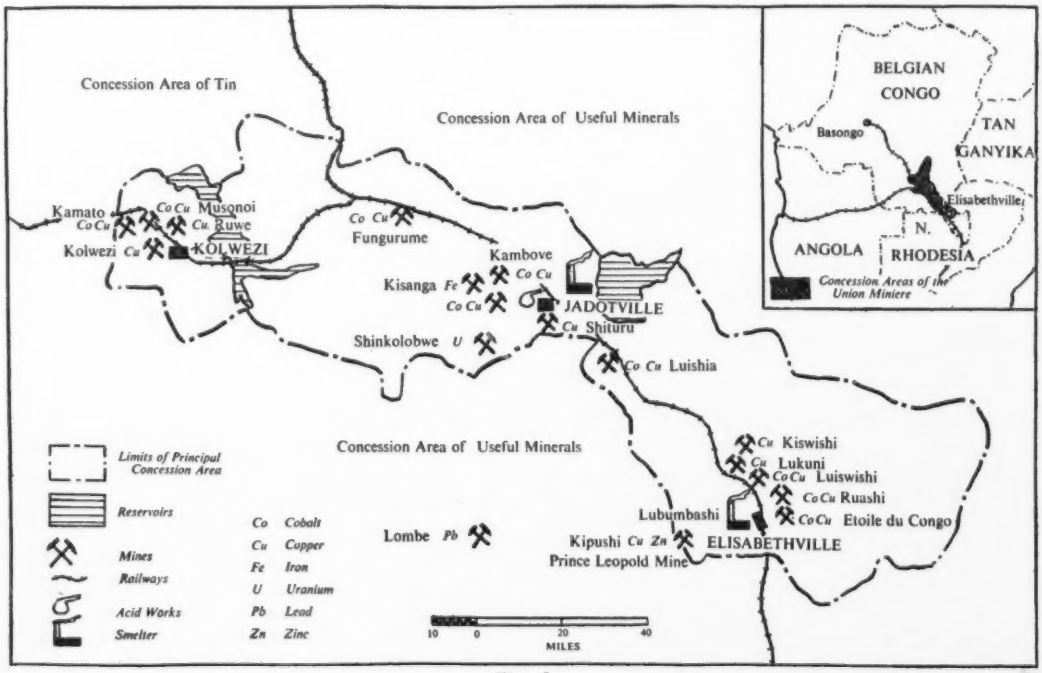


Fig. 2.

modest fertiliser needs which in 1954 totalled 2,000 tons, including about 1,000 tons superphosphate, are also imported, and such acid needs that may arise outside the company's activities are readily met from its ample supplies.

Ore Deposits and Production

The company's mining operations are confined to three adjacent concession areas. The most important, covering some 20,000 square kilometres, contains all the deposits of copper ore and ores permitting the extraction of cobalt, zinc, germanium, cadmium and precious which has a capacity of 90,000 tons per month corresponding to mine capacity. Oxide copper and copper-cobalt ores and mixed oxide-sulphide ores from the western group of mines are treated at the Kolwezi concentrator where since its installation in 1941 capacity has been raised from 50,000 to 200,000 tons per month ore.

In 1954 these two plants produced the following sulphurous materials:—

	Tons	*% Sulphur content*
Copper concentrates ...	265,000	15% (Kolwezi) 25% (Kipushi)
Zinc concentrates ...	150,000	30% (Kipushi)

The output of copper concentrates from Kipushi goes to the Lubumbashi smelter at Elisabethville. Built in 1910, its function to-day is almost exclusively limited to treating sulphide material originating from the Prince Leopold mine.

The sulphur content of the concentrates is removed in Dwight & Lloyd sintering machines and the resultant agglomerate smelted in four blast furnaces yielding copper matte which is converted to blister copper. The exit gases from these operations contain up to 6% SO_2 and are exhausted to atmosphere by a 150 metre high chimney.

Part of the zinc concentrates produced at Kipushi is exported, mainly to Belgium, and part is roasted at the Jadotville smelter of the subsidiary Societé Génerale Industrielle et Chimique du Katanga (SOGECHIM).

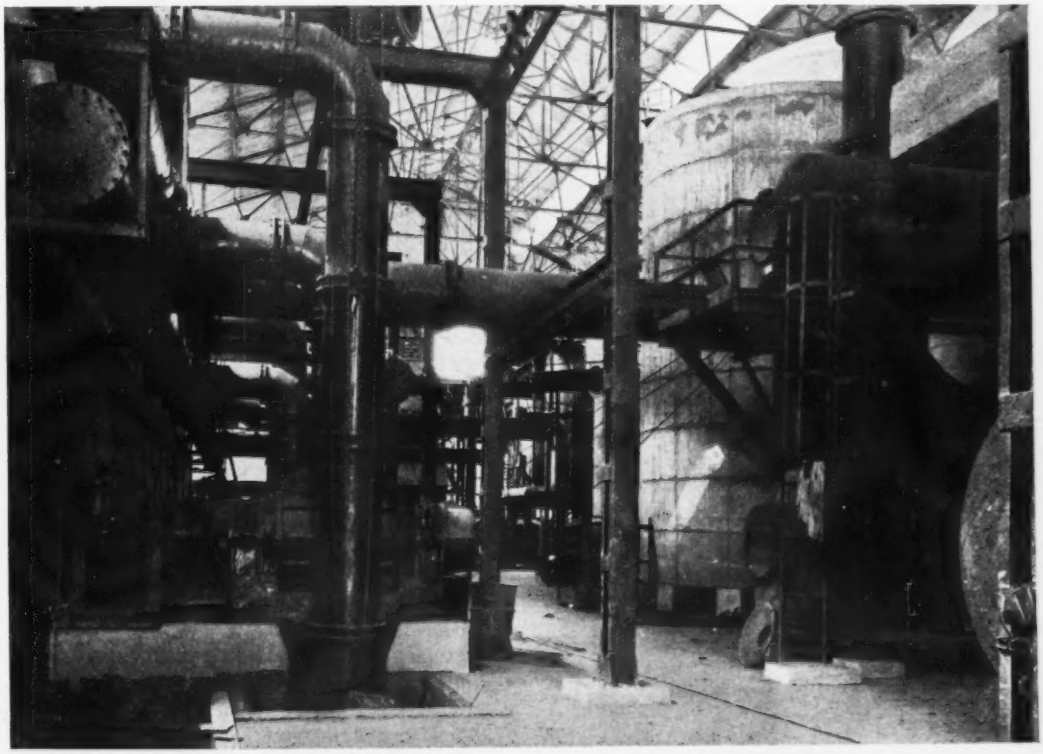
From the resultant exit gases discharged by the four furnaces, the SO_2 content is recovered as by-product sulphuric acid.

Comparative data for recent years are as follows:—

	Crude concentrates		*Zinc calcine*	
	Metric tons			
	Exported	*Roasted*	*Exported*	*Leached*
1952 ...	92,200	66,100	46,800	——
1953 ...	94,000	74,800	31,400	15,000 (appx.)
1954 ...	98,500	103,000 (appx.)	18,500	62,500

Sulphuric Acid

Oxidation of the SO_2 content of the smelter gases is effected by the contact process, employing vanadium catalysts. In a recent expansion programme the capacity of the acid plant was increased to 110,000 tons (100% H_2SO_4) and a further increase to 125,000 tons is foreseen, probably by 1957. Since 1951 actual acid output, which is in the form of 60° Bé acid, has nearly doubled to meet the company's increasing requirements.



Sulphuric acid plant: New 100 tons per day contact unit.

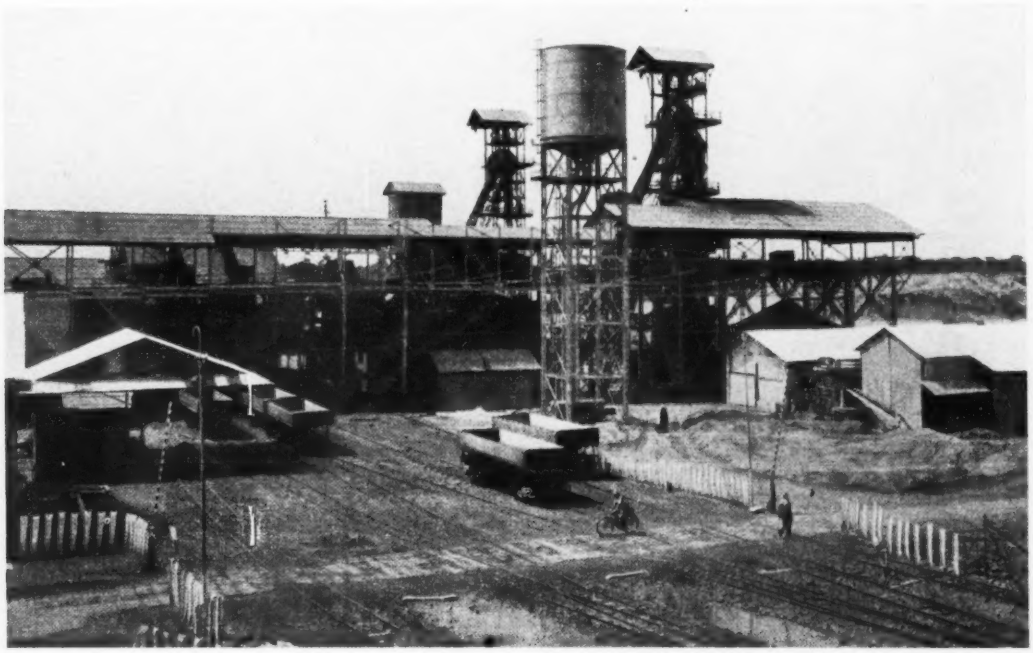
Production in metric tons

	60° Bé	(100% H_2SO_4 equivalent)
1951 ...	42,500	(33,000)
1952 ...	54,300	(42,100)
1953 ...	60,500	(47,000)
1954 ..	83,500	(64,800)

Practically the entire acid output is consumed by Union Minière for metallurgical and ore leaching purposes. At the Jadotville-Shituru works the flotation material originating from the Kolwezi concentrator and precrushed fine grained ores from the Ruwe washing plant are leached in dilute sulphuric acid and from the resultant sulphates, copper and cobalt are recovered by electrolysis. Regeneration by electrolysis of acid used in leaching operations limits actual consumption to acid required to dissolve the gangue and such secondary metals as are not being recovered.

Since 1953, the Societé Métallurgique du Katanga (METALKAT), a subsidary company formed in conjunction with Belgian zinc producers, has been leaching zinc calcines to permit the production of high-grade electrolytic zinc at a rate of 36,000 tons per annum. Previously all zinc calcines were exported mainly to Belgium.

Effective use of the available sulphuric acid production capacity at Jadotville is to be achieved by an increase of tonnage of zinc concentrates roasted in situ. As no significant changes in the rate of concentrate output is foreseen, this is to be achieved at the expense of exports, although by the substitution of calcined material the level of zinc exports is expected to be maintained.



Prince Leopold mine: Pithead installations and new extensions of adjacent concentrator.

New Developments

The increasing quantities of mixed oxide-sulphide copper and copper-cobalt ores originating from the extensive reserves in the western group of mines, notably Kolwezi and Kambowe, which do not lend themselves readily to acid leaching, have led to an intensive examination of new methods of ore treatment. At present the proportion of sulphide ore derived from this source is small, only about 10,000 tons in 1954, and this was added to the throughput of the Lubumbashi smelter. Laboratory experiments subjecting

mixed ores to a sulfating roast have shown promising results. The satisfactory employment of fluo-solid roasters is envisaged, which should permit direct production of a solution of copper and cobalt sulphate. A pilot plant is being built and although no decision as to size and capacity of full-scale equipment has as yet been taken, its installation may be expected in the near future.

The oxidation of the sulphur content of the sulphide ores by the air flow (possibly oxygen enriched) which is necessary to create the fluidised bed effect, results in the conversion of the various metals present into metallic sulphates. Ultimately in the course of the cobalt and copper electrolysis sulphuric acid is generated. Compared with the present treatment of similar ores, the new process would not only result in a significant reduction in sulphuric acid requirements, thereby making the existing output available for other needs, but would itself lead to additional quantities of acid being produced.

Conclusion

The present level of sulphur production and consumption of about 25,000 tons annually, based on the recovery, as by-product sulphuric acid, of sulphur in zinc smelter gases emphasises the diversity of metallurgical operations of the Union Minière du Haut Katanga compared with the neighbouring copper producers in Northern Rhodesia. Even so, and making due allowance for sulphur exported in crude zinc concentrates which, being mostly destined to Belgian zinc roasters, is fully recovered, more than one-half of the total sulphur produced in the form of divers sulphide ores is wasted into the atmosphere.

The introduction of new ore treatment methods may lead to better utilisation, since the relative quantities of sulphur needed to permit efficient sulfating roasting may lead to sulphide ores being diverted from the smelter. Moreover, once the output from the Prince Leopold mine, the source of sulphide ore, declines, the margin between potential supplies and actual sulphur recovery may narrow.

As sulphuric acid consumption is practically wholly confined to the company's copper, cobalt, zinc and probably also uranium ore leaching operations and the requirements of the electrolytic plants, it would be impracticable to define a long-term trend, since new ore treatment methods and new types of ore could result in significant fluctuations of demand.

Over the next two-three years the integrated sulphuric acid operations are likely to rise to 35,000-40,000 tons sulphur annually, but any greater use of available sulphur resources would have to depend on development of other sulphur or sulphuric acid-using industries in the Belgian Congo, notably of fertiliser manufacture, which is, however, not yet in sight.

We are indebted to Union Minière du Haut Katanga of Brussels for the information and photographs which they kindly placed at our disposal.

Prices and Trends

Prices

AS the result of the increasing volume of sales of Mexican sulphur a two-price structure is clearly emerging in world markets. Exports of U.S. sulphur which continue to account for 92% of world trade remain based on a price of $31 per ton f.o.b. for bright sulphur which in case of off-colour grades is discounted by $1-1.50. In preferential markets the export price may be further reduced by other allowances, which in an extreme case, such as Canada, bring it into line with U.S. domestic price structure. The clamour for an abolition of the differential between domestic and export prices is, however, not receiving favourable consideration by U.S. producers notwithstanding the support for this by a section of the domestic consumers who argue that it would make domestic supplies available more freely, as producers would lose the incentive of higher revenue on part of their output.

The intensive sales promotion of Mexican sulphur is essentially based on the favourable price comparison with established U.S. supplies. Whereas initially much of this differential was lost by qualitative shortcomings—mainly lack of uniformity of material rather than the presence of bitumen which is similar to U.S. off-colour grades — the steady improvement in quality that is being achieved is conferring a

genuine price advantage. The majority of sales appear to be effected at about $26.50 per ton f.o.b., but in exceptional cases quotations as low as $24.50 are presented to overcome sales resistance.

The Ente Zolfi Italiani has stated as their official policy that they intend quoting Italian sulphur competitively with other world supplies. Whereas the Government " support " payment of Lire 11,000 per metric ton authorised in March is designed to help producers paying arrears of salaries and maintaining output, the latest Government measure of an export subsidy of Lire 10,000 per metric ton (£5 16s. per ton) aims at assisting Ente Zolfi Italiani to liquidate the large stockpile.

No change in earlier official quotation of the price of Gialla Superiore (minimum 99.5% sulphur) at Lire 27,000 per metric ton (£15 14s. per ton) appears to have been made, but as the bulk of this grade is consumed by the domestic market the quotations of Gialla Inferiore (min. 99%) and Buona Sicilia (min. 98%) are more applicable to the export market. In recent months supplies of both grades are reported to be of good quality bright yellow and up to 99.5% actual sulphur content — at prices of Lire 23,000-24,000 (£13 6s. to £13 9s. per ton. At present Ente Zolfi Italiani are negotiating the sale of a substantial proportion of the stockpile to the U.S.S.R. and a growing volume of sales, some on a long-term basis, are reported to have been made by Ente Zolfi Italiani to neighbouring countries where Italian sulphur enjoys a freight advantage.

The effective price of Chilean sulphur remains, with the aid of compensating commodity imports in the region of U.S. $20 per metric ton f.o.b. As its delivered cost is now being related to that of Mexican sulphur rather than to that of U.S. origin, a slightly greater margin has to be allowed by Chilean commodity importers to facilitate the transaction, but this has not caused any slackening of demand or ready availability of importable compensating commodities notably from Western Europe and Scandinavia.

The following table shows a comparison of prices of sulphur of different origin. F.o.b. prices and freights are based on recent quotations:—

	f.o.b. Country of origin	*Freight to U.K.**	*per ton c.i.f. U.K.*
U.S.A.	U.S.$29.50 - 31	90/-	£15 - £15 5/8
Mexico	U.S.$25 - 27.50	95/-	£13 3/4 - £14 5/8
Italy/Sicily	L.23,000	67/6	£16 5/8
Chile	U.S.$18 - 22	115/-	£12 1/4 - £13 3/8
Japan	U.S.$34†	115/-	£17 7/8
Ecuador	U.S.$42	120/-	£21
Canada	$20 ex works	115/-	£19 5/8

Pyrites

Although the price of European pyrites has been under strong pressure in recent months, no change in the present price level of £4 15s. to £5 5s. per metric ton f.o.b. is expected for deliveries during the first half of 1956. This is primarily due to the maintenance of the price of Spanish pyrites which the Spanish authorities, who effectively control its level, are reluctant to reduce since a small reduction would not result in an increased volume of exports whereas a major reduction would cause too great a loss of foreign exchange revenue and also upset the present equilibrium in the European pyrites price structure.

Ground Sulphur

The price of ground sulphur exported from the U.S.A. has weakened in recent months, dipping as low as $48 per ton f.o.b., but the bulk of exports was effected at about $54-56. German and Belgian supplies which are securing a sizeable proportion of the world market are reported from £21.10-£23.10 per metric ton f.o.b. for 300-325 mesh material. Exports from the U.K. at about £25-£26 per ton f.o.b. are rising, particularly to Commonwealth destinations where they enjoy preferential tariffs.

Supplies

The reversal of the policy by U.S. producers, who had been restricting output during the first half of this year, has resulted in the effective use of available Frasch sulphur capacity and record tonnages have been produced in the third quarter and probably also in the fourth quarter. In consequence, the earlier stock depletion has been halted and the heavy domestic demand, some 12-15% greater than in 1954, is now being met out of

*—Based on bulk cargoes of 5,000-6,000 tons on the usual sulphur terms of chartering.
†—Calculated on basis of sales in Australia.

production, without affecting export shipments which are running at about the same level as last year.

U.S. producers appear to be confident in being able to maintain the present level of production and are continuing to promote their export markets, where inroads by Mexican supplies have not yet caused any significant changes.

The principal outlet for Mexican exports, which up to end September totalled about 119,000 tons, has been the U.S.A. and this market is assuming increasing importance as the expansion of outlets in other directions is proving to be slow mainly on account of the quantitive limitation of markets. In view of the improvement of the level of output in recent months it is probable that stocks of the two established Mexican producers at the end of the year will total about 320,000 tons which is equivalent to about 65% of annual production compared with a ratio of 52% carried by U.S. producers.

Export shipments of Italian sulphur have been resumed on a modest scale, and sales to neighbouring and Iron Curtain countries of about 12,800 tons have been effected in the third quarter. Current negotiations for a sale of 50,000 tons to the U.S.S.R. — already authorised by the Italian Government — would, if successful, lead to a substantial reduction of the stockpile which at the end of September totalled 354,000 tons sulphur of various grades. Actual output is being maintained at a rate of about 22,000 tons per month, and at the current rate of domestic use an exportable surplus of about 100,000 tons for 1955 is expected.

Although the resumption of mining operations in Chile following a rather severe winter has raised the level of refining operations, supplies being made available to domestic users are still considered to be insufficient. Producers continue to take up export commitments in excess of their immediate ability to make delivery as the various compensatory transactions enable them to realise an attractive Peso revenue.

In recent months high domestic demand in Japan has exceeded available supplies. Consumers are at present faced with a sulphur shortage and following their urgent representation, the Government has authorised the import of several thousand tons during the fiscal year ending 31st March, 1956. The start of operations of a modern refining installation by the Matsuo Mining Company, the largest producer, may help to remedy the present shortage of supplies towards the end of next year.

Pyrites

Demand for pyrites in Western Europe is expected to remain unchanged, with the exception of Western Germany, where usage is expected to rise by about 30,000 tons in the first half of 1956. Reduced requirements in the U.K. and possibly in Belgium are likely to affect mainly Spanish exports. Overall supplies are adequate, but in view of Italy's rising requirements domestic supplies will have to be increasingly supplemented by imports. The relatively greater rise in Mediterranean freights, is expected to favour the movement of a larger volume of Canadian pyrites concentrates which coupled with greater domestic needs should lead to new high level of pyrite concentrate recovery and mine shipments.

Summary

Ample supplies of Frasch sulphur and the increasing application of sulphur recovery promise to satisfy growing world demand. The anticipated increase in sulphuric acid requirements is being met by new plant construction based almost exclusively on the use of brimstone, which promises to account for a relatively larger share of total sulphur consumption compared with the use of sulphur in other forms. Growing non-acid sulphur needs in particular for pulp and rayon manufacture and to a lesser extent, and of course subject to climatic conditions, for agricultural use, may exert pressure on bright sulphur supplies but not sufficiently to result in a price advance. The increasing volume of off-colour sulphur supplies, shortly to be augmented by additional new production in Mexico, is expected to ensure the maintenance of the present competitive position in the world sulphur market.

UNITED STATES SULPHUR

Native Sulphur

PRODUCTION of Frasch Sulphur during the third quarter amounted to 1,486,934, the highest quarterly total on record, exceeding that of the preceding quarter by 13%, that of the corresponding period of 1954 by 8½%, and the previous highest output, which occurred during the first quarter of 1954, by 108,700 tons (8%).

Output of 500,710 tons in August was the highest monthly total achieved to date, but both July and September productions also exceeded the previous record month. A large proportion of the additional output is reported to originate from the Freeport Sulphur Company's domes and satisfactory results also appear to have been achieved by the Jefferson Lake Sulphur and Duval Sulphur and Potash Companies.

Apparent sales receded seasonally to 1,361,975 tons, and although 11% lower than in the preceding quarter, they exceeded sales during the corresponding period of 1954 by 16,000 tons (1¼%). The seasonal decline was mitigated by the continued buoyancy of of industrial activity, which in the third quarter was expressed by a further advance of two points of the production index to 141 (1947/9 =100). Sulphuric acid production of over 3.6 million short tons reflected the strong industrial demand which was, however, offset to some extent by seasonally low requirements for fertiliser manufacture. The largest users were the Steel industry—in September the steel rate rose to 95.7—rayon and detergent manufacturers and oil refiners for alkylation.

With regard to the activities of the fertiliser industry, the recent forecast for the 1955/6 crop year by the U.S. Department of Agriculture is of interest. An increase in Fertiliser supplies of 2.5% is expected, represented by an anticipated growth of 4.4% of Nitrogen and 4.3% Potash supplies, while Phosphate fertilisers are expected to remain at last year's level. It is therefore probable that, following the loss of production due to strikes in the phosphate industry earlier this year, above average activity may be apparent in the late autumn and in consequence high sulphuric acid demand in this sector of the industry.

Non-acid sulphur demand in the third quarter was exceptionally strong compared with similar periods in other years, as the result of increased carbon disulphide requirements in rayon manufacture and particularly owing to the consistently high level of activity in the pulp industry which in August resulted in the highest monthly level of sulphur dioxide manufacture.

Exports in the third quarter amounted to 434,464 tons, about 5,000 tons less than during the same period of 1954. At the same time about 25,000 tons were imported from Mexico, the first sizeable elemental sulphur imports since before World War I when Sicily lost the U.S. market.

As the result of output reaching new high levels during a relatively slack period of demand, the depletion of mines' stocks of the first half-year was reversed. At the end of September Frasch sulphur stocks totalled 3,000,346 tons, an increase of 124,959 tons (4½%).

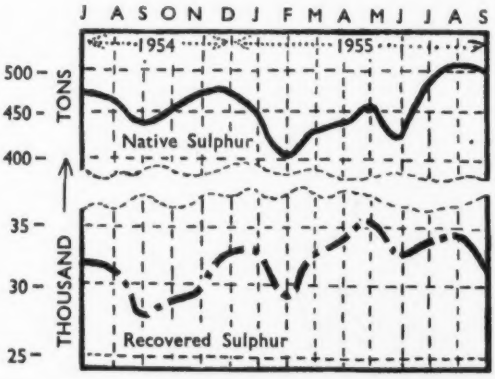


Fig. 3. Monthly Production

Recovered Sulphur

Production of sulphur recovered from natural and oil refinery gases during the third quarter amounted to 99,200 tons. Although about 2¾% lower than during preceding record quarter, it exceeded output during the corresponding period of 1954 by 9,400 tons (10½%).

Continuing their seasonal increase, apparent sales totalled 115,737 tons, 13,000 tons (13%) higher than in the preceding quarter, but they failed to reach the record level of sales during the corresponding period of 1954 by 3,300 tons (2¾%).

Stocks declined 16,537 tons (13½%) to 106,729 tons at the end of September.

Summary—Third Quarter 1955

(a) Frasch Sulphur production at a new record level and continued high output of recovered sulphur resulted in a total of 1,586,134 tons brimstone being produced. In consequence output for the first nine months of 4.38 million tons attained virtually the same level as that in 1954, i.e. an annual rate of about 5.85 million tons.

(b) Apparent sales of Frasch and recovered sulphur totalling 1,477,712 tons during the third quarter raised the total for the first nine months to 4.61 million tons. Exports of 1,193,624 tons were only about 5,000 tons greater than during the first nine months of 1954, and the level of total sales, 10½% above that of 1954, reflects the increased domestic demand in the U.S.A.

(c) Although stocks of Frasch and recovered sulphur increased by about 108,400 tons during the third quarter, they were at the end of September still 230,000 tons smaller than on 1st January.

In view of the continued high level of industrial activity during the closing months of the year, when renewed demand for fertiliser manufacture is exerting pressure on sulphur and sulphuric acid supplies, it may be anticipated that U.S. domestic sulphur consumption in 1955 will exceed that of 1954 by 12-15%. Thus domestic brimstone requirements of about 4.6-4.7 million tons and export shipments expected to total 1.7 million are likely to exceed output by at least ¼ million tons, notwithstanding the probable continuation of peak production. Under the circumstances, imports of Mexican sulphur which started in the third quarter of this year are assuming increasing importance.

Sulphur in Italy

Production and Stocks

PRODUCTION of elemental sulphur during the third quarter totalled 66,960 metric tons, making total output for the nine months of this year 166,443 metric tons. With the aid of Government subsidies the Ente Zolfi Italiani have been able to reduce their export prices and to re-enter export markets on a modest scale. In the third quarter exports totalled 12,809 tons which included sales to France (2,800 tons), Tunisia (1,850 tons), Austria (120 tons), Poland (650 tons), Czechoslovakia and Yugoslavia. At the same time the domestic market took up 30,135 tons so that the additions to stockpile amounted to only 14,018 tons, the lowest quarterly total since the end of 1952. At the end of September the stockpile totalled about 354,000 tons, made up as follows:—

Gialla Superiore	(min. 99.5% S) ...	42,799	tons
Gialla Inferiore	(min. 99 % S) ...	142,598	„
Buona Sicilia	(min. 98 % S) ...	146,362	„
Corrente	(min. 95 % S) ...	22,064	„

The advantage of more favourable shipping costs should facilitate Ente Zolfi Italiani efforts to secure a greater share of the sulphur trade in neighbouring countries. Although there is provision for the delivery of sulphur under the many bi-lateral trade agreements concluded by the Italian Government, realisation depends more than ever on the Ente Zolfi Italiani's ability to quote competitively. In this connection the views expressed by Count Faina—Chairman of Montecatini and member of the Board of Ente Zolfi Italiani—at the recent meeting of the Italian Group of the European Committee of Economic and Social Progress are of interest, although his deductions do not appear to take into account all significant developments in the world supply position, notably those in Mexico.

"In regard to sulphur, a deep-seated structural organisation acting even under provisions of the Central and Regional Governments would certainly be destined to bring about a reduction in production costs sufficient to bring Sicilian sulphur nearer to international prices. To this may be added two well-founded theories, namely, the drop

in U.S. sulphur output and the increase in the world demand which, in the next 10 years, could increase by about four to five million tons. On these well-founded and legitimate conclusions the Sicilian sulphur industry can have a future."

Government Subsidies

At the end of November the Finance and Treasury Commission of the Italian Chamber of Deputies approved a bill under which the Italian Government could subsidise exports of Italian sulphur to the extent of Lire 10,000 per metric ton (£5 16s. per ton). This subsidy is designed to reimburse the Ente Zolfi Italiani for losses incurred in selling sulphur from their stockpile at competitive world prices.

This does not affect the financial assistance granted by the Government, in March of this year, to Italian producers who are receiving Lire 11,000 per metric ton sulphur in the form of an emergency bank advance to enable them to pay salary arrears and to maintain production. It is intended that these advances should be repaid at a later date.

Concurrently with the export subsidy the Government also authorised an increase in the statutory ceiling of Government expenditure on reorganisation and modernisation of the Italian sulphur industry from 9,000 to 12,000 million Lire (£6.85 million). Originally authorised in 1951, total expenditure based on application by producers totalled about 4,000 million Lire by June, 1955, in respect of work at nine mines. The decision by Regional Government of Sicily to provide the necessary guarantees instead of the Bank guarantees hitherto required should accelerate the programme.

Sulphur in Mexico

General

IN recent weeks production of Frasch sulphur at Jaltipan and San Cristobal domes has been rising significantly and it is reported that current output is ranging from 2,200-2,500 tons sulphur per day. At the same time development work is progressing at three other sulphur dome projects, two of which, with a combined daily capacity of about 800 tons sulphur, are expected to be in operation early in the New Year.

Important plans for the expansion of sulphur recovery facilities from natural and oil refining gases promise to raise output from this source from the present 120 tons per day to nearly 300 tons per day by 1957.

Frasch Sulphur Production

Pan American Sulphur Company

Since the formal start of commercial production on 1st April, six months after steaming started at Jaltipan dome, the expansion of output has been such that, according to the president, Mr. H. C. Webb, the company confidently expect to produce over 400,000 tons sulphur in 1955. During the summer operations suffered a serious setback when, due to a break in the bleed water reservoir embankment, the river water upstream from the intake pumps became excessively contaminated with sodium chloride, necessitating a temporary shut-down of pumped water supplies to the boiler plant. Output which previously had averaged 1,600 tons a day dropped to a few hundred tons, but since the resumption of normal working it has risen to over 2,000 tons a day at the beginning of December. The planned output of 1,700-2,000 tons per day for the first half of 1956 is to be increased by 50% as from July, 1956, when expansion work, at present in progress, is due to be completed. These facilities include a filtering system with a handling capacity of 1,000 tons off-colour sulphur per day which is expected to be in operation during February. If necessary, it will permit the production of bright sulphur, but it is understood that in the ordinary way it will be operated to reduce the carbon content of the marketable output to under 0.3%.

The actual sulphur operations in Mexico are executed by a subsidary of the U.S. parent company and in recent months its name—Gulf Sulphur de Mexico S.A.—which, due to its similarity to that of another producer, had caused much confusion, was changed to Azufrera Pan-Americana S.A.

Mexican Gulf Sulphur Company

The organisational and technical difficulties which had caused the output at the company's San Cristobal dome, the first

operational Frasch sulphur producer outside the U.S.A., to decline to less than 200 tons per day earlier this year, were successfully resolved and by early November daily production reached 575 tons. A significant feature of operations is the relatively low water requirement of the company's producing wells which at present yield one ton of sulphur to about 2,000 gallons of water.

Production, which during the first nine months of 1955 amounted to about 57,000 tons, is expected to total over 90,000 tons by the end of the year, following the satisfactory results achieved in October and November. The extension of operations to wells brought to the production stage promises to raise daily output to 600-700 tons early in 1956.

In the meantime pumping installations at both mine loading and Coatzacoalcos dock-side unloading points, at present rated at 500 tons per day, are being expanded to permit the movement of the increasing output. The erection of a filtering plant is also foreseen in the New Year.

Texas Gulf Sulphur Company

The company's Mexican subsidiary, Cia Exploradora del Istmo S.A., is reported to have obtained satisfactory results in the course of exploratory work on a dome formation near Sante Anita which adjoins the concession area of the Gulf Sulphur Corporation. Operating plans provide for the installation of boiler and pumping plants on a barge which is to be stationed near Nopalata, about one mile upstream from Las Salinas on Coachapa River. Initially the plant is to have a daily capacity of one million gallons of water which, on the basis of results achieved at other Mexican domes, may permit the production of 200-400 tons sulphur per day. The deposit is estimated to contain one million tons sulphur and the decision to mount the plant on a barge was

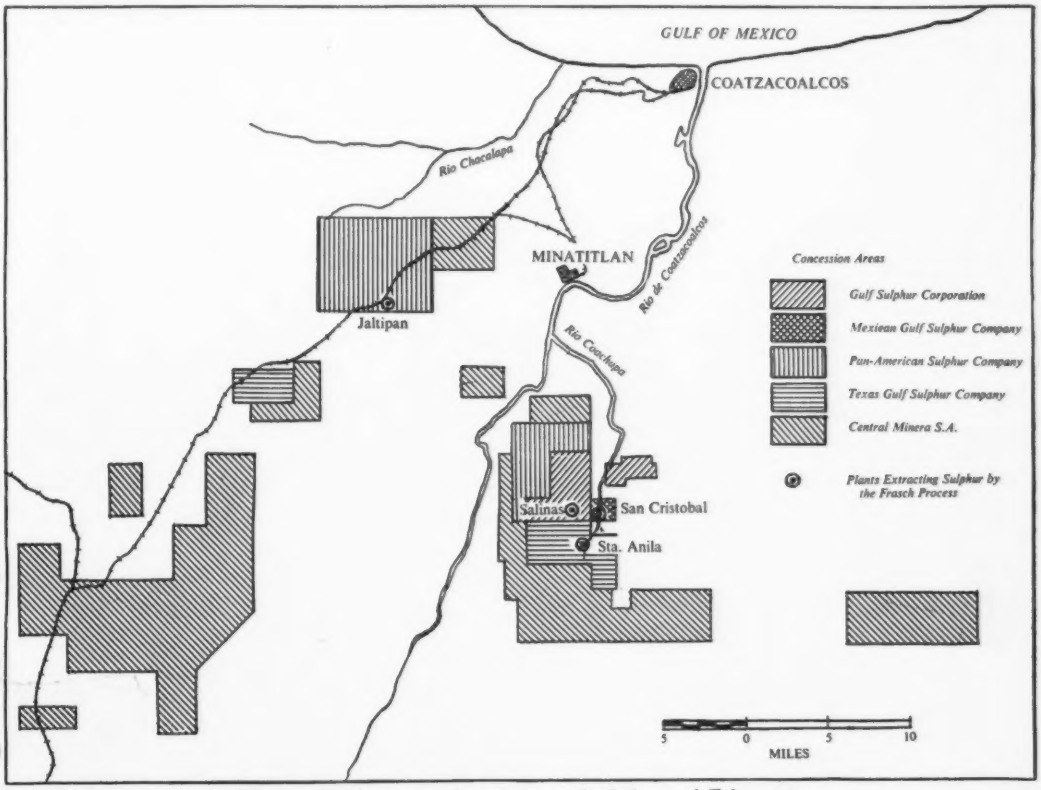


Fig. 4. Sulphur concession areas on the Isthmus of Tehuantepec

taken to facilitate its removal should operations prove disappointing.

Gulf Sulphur Corporation

During the early autumn construction work at the company's Las Salinas dome suffered unavoidable delays due to excessive rains, but according to Mr. Stuart Dorman, the company's executive vice-president, the plant was completed in the early part of December and ancillary buildings for the staff and road making were then on the point of completion.

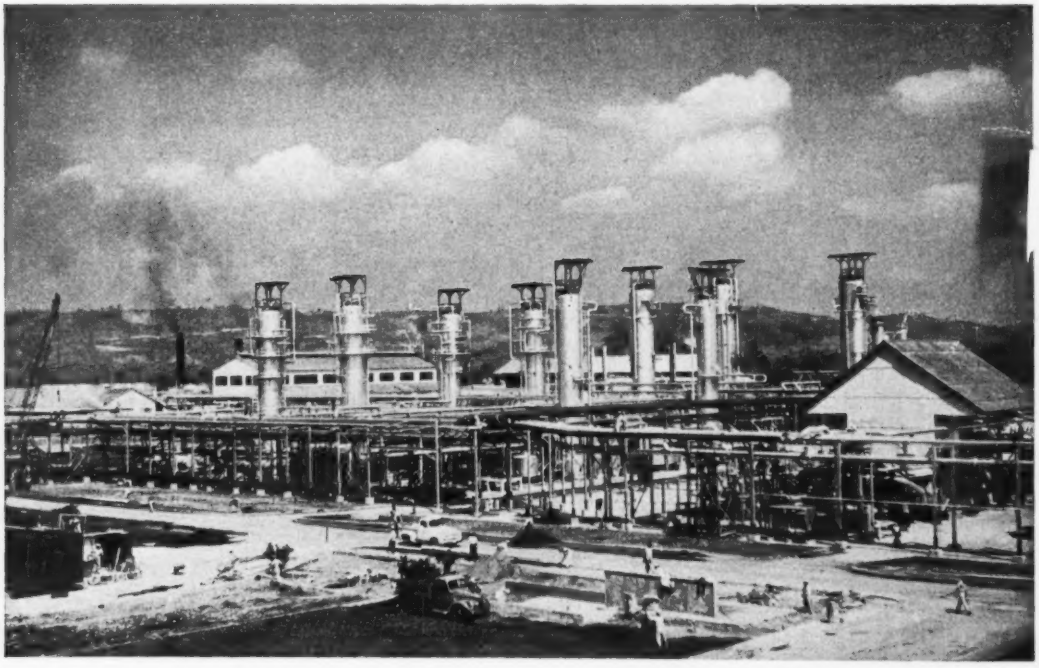
Oil storage and shipping facilities in the form of two barges are ready and two sulphur barges each capable of carrying 600-800 tons sulphur are under construction at Houston. The company recently commissioned the Hudson Engineering Corporation to build dock and loading facilities in the free port area of Coatzacoalcos, adjacent to the installations of Mexican Gulf Sulphur Company, on a site which has storage space for several hundred thousand tons sulphur. Construction is to start immediately.

It is planned to start steaming the dome early in the New Year and it is expected that by February reliable indications of yield, quality and colour of the sulphur will be available.

Texas International Sulphur Company

Refining by autoclave of native sulphur ores mined by the company in Lower California continues to yield about 7,000 tons refined sulphur annually. No further plans have yet been announced concerning the exploratory work on dome sulphur deposits in the Isthmus region. Some of the concession rights, formerly held by their subsidiary, Central Minera S.A., appear to have been granted recently to a wholly Mexican undertaking — Azufres de Mexico. The area in question, extending over 37,065 acres, adjoins that held by Texas Gulf Sulphur on the Coachapa River.

In the course of the recent reorganisation of the company, Mr. Dale Major has been appointed President of the company following the resignation of Mr. Victor Dykes.



General view of the Natural Gas Treatment and Sulphur Recovery Plant at Poza Rica

Recovered Sulphur

At the world's second-largest sulphur recovery plant at Poza Rica, State of Vera Cruz, extensive development plans are being put into effect by Petroleos Mexicanos (PEMEX)*, the Mexican State-owned oil industry.

Designed to treat daily 275 million cubic feet natural gas, containing about 4% sulphur, the Poza Rica plant was built in 1951, with a daily capacity of 120 tons sulphur of high purity (min. 99.9%).

process. Notable features of the gas treatment and sulphur recovery plants are the efficient recovery and use of waste heat and the application of a stainless steel conveyor belt —the first of its kind to be so used—on which the liquid sulphur stream solidifies at a thickness which conveniently breaks on discharge into storage bins. The cleaned gas flows to a conventional gas absorption installation comprising two units, each rated at 120 million cubic feet gas daily, where the liquid products are separated.

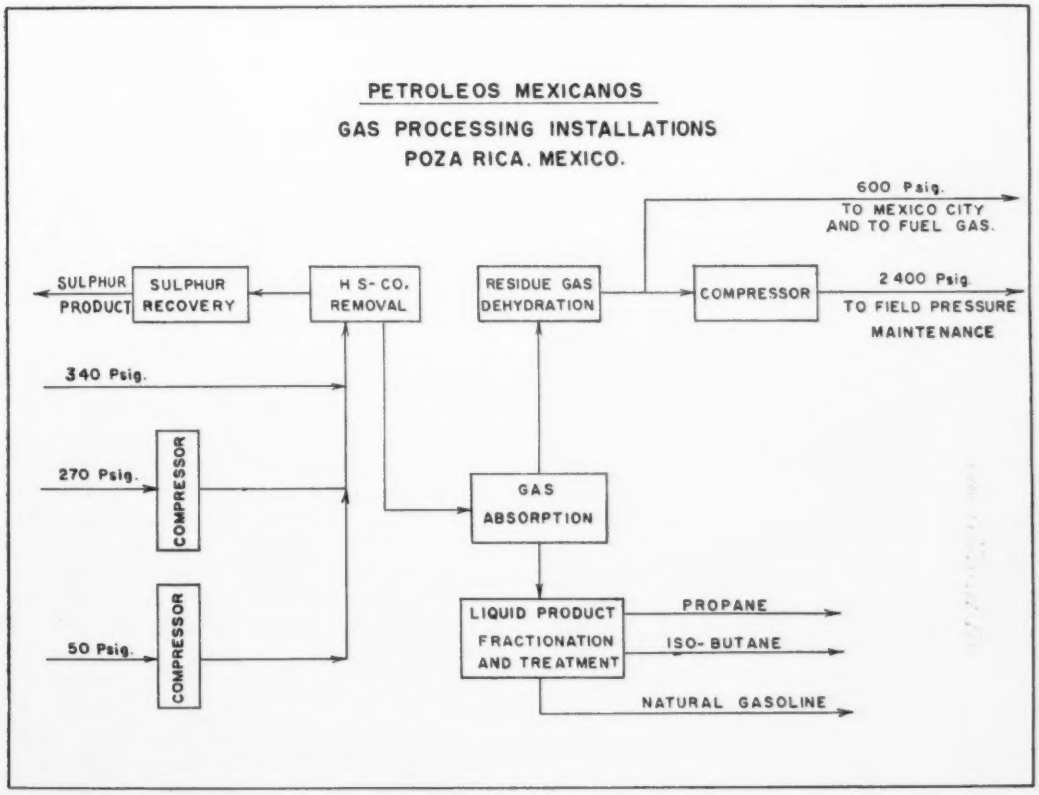


Fig. 5.

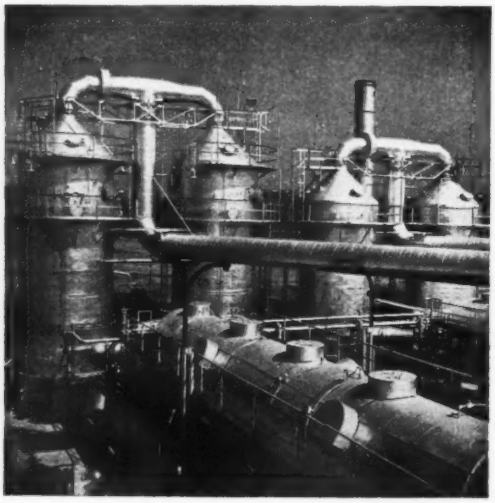
Crude gas, after passing through a series of compressors, is fed through three parallel processing units to the Girbotol amine-type purification plant. Conversion of the extracted hydrogen sulphide is effected in the adjoining recovery plant, which is based on the Claus

After four years of constant production of up to 130 tons sulphur daily, the plant is now being expanded to a rated capacity of 240 tons per day. Construction work is well advanced and output at the new level is expected by the end of 1956.

*We are indebted to Petroleos Mexicanos for information placed at our disposal.

This increased level of activities is thought to be primarily due to the growing gas requirements of the province and in particular of Mexico City. The large-scale exports to the U.S.A. of Mexican natural gas, which were recently ratified by both Governments, does not affect this project, as the gas is derived from wells in N.E. Mexico which yield sweet gas.

Simultaneously plans are being completed for the construction of two sulphur recovery plants designed to treat oil refinery gases. Crude oil from the Poza Rica Field contains about 2.5% sulphur, and that from the Pánuco field 6%. With a view to recovering the sulphur content liberated in the course of refining operations, the Madero Refinery at Tampico is to be equipped with a 30-ton per day sulphur recovery plant, and that at Mexico City with a plant rated at 25 tons sulphur daily. It is expected that both plants will be in operation by the end of 1957.



Poza Rica Sulphur Recovery Unit.

Marketing and Exports

During the first nine months of this year exports of Frasch sulphur totalled about 119,000 tons†, shared in the ratio of 5:3 between Pan American Sulphur and Mexican Gulf Sulphur Companies. The latter also supplied about 10,000 tons to domestic users. The principal supplier of the domestic market is Petroleos Mexicanos, whose deliveries up to the end of August of 16,132 tons meet the needs of some 130 users in the various sections of industry. It is expected that in 1955 total exports will amount to about 230,000 tons Frasch sulphur, and deliveries to the home market about 35,000 tons recovered and Frasch sulphur. By the end of the year stocks should total about 320,000 tons, of which Pan American expect to hold about 250,000, Mexican Gulf about 70,000 tons, and Pemex up to about 3,000 tons.

Consumption of sulphur in Mexico promises to increase rapidly. Of the various new projects* the majority are concerned with sulphuric acid/fertiliser manufacture, but the level of non-acid sulphur usage is also expected to rise mainly due to the expansion of rayon and cellulose film manufacture. The latter started in September, when a new plant at Monterrey, with an annual capacity of 1,800 tons film, started production. Amongst the fertiliser projects, the construction is envisaged at the steel works of Altos Hornos and Demenclova in North Mexico of a U.S. $12 million synthetic ammonia plant by a Franco-Mexican group comprising Nacional Financiera, Banque Nationale pour le Commerce et l'Industrie et the Cie. St. Gobain. A similar development aimed at increasing ammonium sulphate production is planned at the Monclova steel mill and at Guantitlan, where superphosphate production started last year.

Summary

The expansion of existing capacity and the advent of new Frasch sulphur production hold promise of 900,000 tons of Frasch, recovered and rock sulphur being produced in Mexico during 1956, and over 1½ million tons in 1957. Domestic needs, providing secure outlet, are expected to rise rapidly to about 150,000 tons annually by 1957. Disposing of the vast export surplus will present for the time being a major problem.

† For details see Statistical Appendix.
* See also Bulletin No. 10, p. 32.

ELEMENTAL SULPHUR IN JAPAN

THE consumption of elemental sulphur, which had been increasing steadily for the past two years, has in recent months exceeded the sulphur producers' ability to meet domestic requirements. It is reliably estimated that the use of elemental sulphur for rayon and pulp manufacture, rubber compounding, agriculture and miscellaneous purposes will total at least 110,000 tons during the period July-December, 1955, 22% more than the annual rate of consumption in 1954. Japanese producers also have to meet a contractual export obligation of over 3,000 tons, whilst an authoritative assessment of production during this period indicates that at best an output of 113,900 tons may be achieved. In view of the narrow margin of production over consumption and exports during recent years both consumers' and mine stocks are small and the adverse supply position has caused alarm.

Consumers faced by a threatened shortage impressed the Government sufficiently, in spite of protests from sulphur producers, for imports of several thousand tons sulphur to be authorised for the fiscal year ending 31st March, 1956.

At this critical period the modernisation plans of the *Matsuo Mining Company*, which were decided upon some eighteen months ago and which were given effect in an intensive study of modern refining methods and in experimental work by the company's engineers, have reached a satisfactory stage.

Early in 1955 the design and construction of a pilot plant with a capacity of 500 tons refined sulphur per month were started; this was completed and the furnace fired on 19th August. Its operation to date is reported to be fulfilling expectations and the company is now planning to erect a full-scale plant during 1956 with a capacity of 2,000-4,000 tons per month which is to be expanded to 6,000 tons in 1957. By then the new installations are intended wholly to replace the present obsolete plant.

In the existing plant, which is based on a batch process, the sulphur ore containing 26% free sulphur, 7% combined sulphur and 2% water, is placed in pot-shaped retorts which are heated in coal-fired furnaces. The average rate of sulphur recovery by this method is at best 80% but usually lower, whereas coal consumption is 40% or more and labour requirements three man shifts per ton of refined sulphur.

The new plant and process, which has been patented, consists of a brick-built furnace comprising distillation and heating chambers arranged alternately in a set of batteries. The slight difference of pressure between the chambers is adjusted automatically and both charging the furnace with crude ore and drawing off the refined sulphur are continuous.

The plant was designed to permit 96% recovery, 25% fuel consumption and 0.3 man shifts per ton of product and these targets were by and large attained in the course of pilot plant operation.

In 1954 the output of the Matsuo Mining Company, the largest individual sulphur producer in Japan, amounted to 57,100 metric tons, 7% less than in 1953. Total output in 1954, which was provided by 28 producers, amounted to 185,700 tons, 2% less than in the preceding year, when a total of 36 producers were active.

The present supply crisis is, in spite of the apparent increase in production of 22½%, almost entirely attributable to antiquated mining operations prevalent amongst all except the few large-scale producers and the uneconomic refining methods in use throughout the industry. Shortage of capital resources and absence of Government aid have mitigated against major modernisation measures and the deferment of the installation of a Masobello plant by the Musa Mining Company is symptomatic.

Although exceptional and probably temporary, the foreseen import of one of Japan's principal indigenous raw materials has focussed renewed attention on the widely practised uneconomic methods of sulphur production and has prompted a vigorous examination of measures to bring about the greater rationalisation of the industry.

UNITED KINGDOM SULPHUR

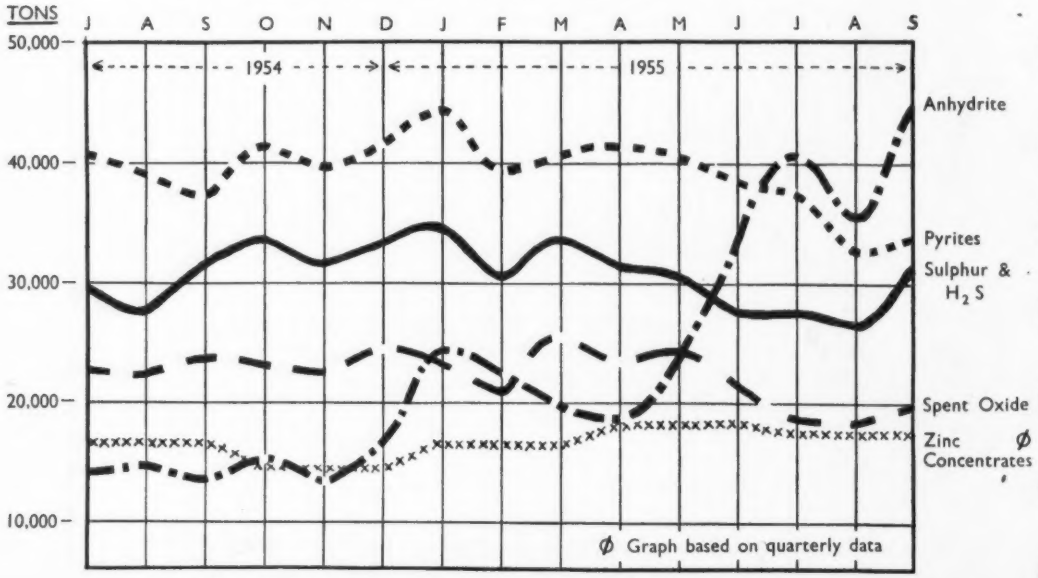
The following review of the sulphur industry in the United Kingdom in the third quarter of 1955 is not comprehensive, since it excludes details of the new anhydrite acid plant of *Solway Chemicals, Ltd.*, at Whitehaven, which, having come on stream in July at half-capacity, recently started operating at the full scheduled capacity of 100,000 tons per annum (100% H_2SO_4). In the absence of specific data on anhydrite consumption, acid output, and end use of acid of this important producer the following details are not strictly comparable with earlier periods, and those principally affected are marked thus †. It is hoped to present an accurate picture in the 1955 summary of the U.K. industry in Bulletin No. 12.

CONSUMPTION of sulphur in all forms* during the third quarter 1955 amounted to 203,000 tons† and, although 5% lower than in the preceding quarter, it was 1% greater than in the corresponding period of 1954. Seasonally low industrial activity in August was followed by an upsurge in September, which is reflected in acid output and regular sulphur usage being slightly in excess of the year's average. The impact of the substantially increased anhydrite acid output at Imperial Chemical Industries Limited, Billingham, and United Sulphuric Acid Corporation Limited, Widnes, is reflected in the recession of spent oxide and pyrites used in acid manufacture, which gained pace during the third quarter. Acid sulphur consumption, although lower, shows a lesser decline.

Consumption of the various raw materials was as follows:—

	3rd Qr. 1955	*2nd Qr. 1955*	*Change§*	*3rd Qr. 1954*	*Change§*
Sulphur	*Tons*	*Tons*	*%*	*Tons*	*%*
Acid	59,700	63,300	−5½	62,200	−4
Regular	26,000	26,100	−½	26,600	−2
Total	85,700	89,400	−4	88,800	−3½
Pyrites	104,100	120,400	−13½	117,000	−11
Spent Oxide	56,400	69,400	−19¼	68,500	−17½
Zinc concentrates	52,400	54,200	−3¼	50,500	−3¼
Anhydrite	120,400†	82,500	+46	42,600	+183

§—Percentage figures shown indicate change between earlier periods and the third quarter 1955.



*—Not including sulphur in anhydrite used in direct manufacture of ammonium sulphate which is expected to total 211,000 tons in 1955

It is estimated that of the above total consumption 40% was met from indigenous sources (sulphur in spent oxide, anhydrite, zinc smelter gases and recovered from coal and oil refinery gases), 24½% in the form of imported pyrites and 35½% in the form of imported brimstone. Actual imports in the third quarter amounted to 91,861 tons of brimstone (valued at £15 11s.) and 140,339 tons pyrites (valued at £7 8s. 6d. per ton).

Sulphuric Acid*

Production of sulphuric acid during the third quarter amounted to 490,700† tons (100% H_2SO_4). It was 6% less than in the preceding quarter and only fractionally (¼%) higher compared with the corresponding period of 1954.

Acid production resulted from the use of the following raw materials.

	3rd Qr. '55	2nd Qr. '55	3rd Qr. '54
Sulphur:	%	%	%
Imported brimstone ...	31	33¾	35¾
Recovered, in H_2S and filter cake	2¾		
Sulphur in			
Pyrites	28	30¾	31½
Spent oxide ...	15½	17¾	18¾
Anhydrite ...	14¼†	9¼	5¼
Zinc concentrates	8¾	8½	8¾

During the third quarter effective production capacity rose further by nearly 4% to an annual rate of 2.65† million tons of which only 74.1% was employed. The apparent increase, represented by about 100,000 t.p.a. contact acid capacity is mainly attributable to the start of operations of a wet-contact sulphuric acid plant of Messrs. Brotherton & Co. Limited at Birmingham and to the full impact during the quarter of available capacity at the anhydrite acid plant of United Sulphuric Acid Corporation Limited, Widnes.

Employment of sulphur burning and pyrites roasting capacity receded further to about 69% while that of spent oxide fell back to 71%. Acid production from zinc smelter gases continued to exceed rated capacity.

Consumption of sulphuric acid amounted to 489,600 tons† (100% H_2SO_4), fractionally (¼%) more than during the third quarter 1954.

The principal changes in individual consuming industries compared with the corresponding period of 1954 were as follows:—

	Change Tons	Change %
Superphosphate	+10,100	+11
Soap, glycerine, and detergents	− 5,600†	−41
Rayon and transparent paper ...	− 5,500	− 8½
Titanium dioxide	+ 4,700	± 9
Bromine	− 3,900	−60
Agriculture	− 3,700	−55

Significant changes in acid consumption, although quantitively smaller, were recorded for plastics (+32%), drugs and fine chemicals (−36%), accumulators (+37%).

Acid usage by the main consumer groups was approximately as follows:—

	000 tons	%
Fertilisers	169	34.6
Chemicals (estd.)	58	11.8
Titanium and lithopone	62	12.7
Rayon and transparent paper ...	59	12.1
Iron and steel	26	5.3
Oil refining.....	15	3.1
Dyes	20	4.1
Miscellaneous	80	16.3
	489	100.0

Raw Material Stocks

During the third quarter 1955 stocks of acid and regular sulphur increased 21,200 tons (26%), the largest quarterly increase since the stocks depletion was halted in the first quarter 1954. At the current rates of consumption the stocks available at the end of September of 103,200 tons are sufficient to meet 16 weeks requirements. Pyrites stocks rose by 38,900 tons (20%) to 230,400 tons and those of spent oxide also increased, for the first time since the third quarter 1951, by 2,200 tons (2%) to 127,000 tons, both representing about 29 weeks supply at current rates of consumption.

The most significant features of developments in the sulphur industry during the third quarter are:—

(a) The substantial increase in the proportion of acid manufactured from anhydrite, even without making allowance for the impact of production at the Whitehaven plant of Solway Chemicals Limited.

(b) The strong decline in the use of pyrites and spent oxide as a direct result of anhydrite supplies being available.

(c) The slowing down of the reduction in acid sulphur usage.

These trends are expected to become even more pronounced in the immediate future.

*—We are indebted to the National Sulphuric Acid Association for information placed at our disposal.

Whereas in the third quarter the bulk of the anhydrite acid output of Solway Chemicals Limited was consumed by their parent company, thereby causing only a loss of outlet to their previous suppliers, the necessity to dispose of up to 60,000 tons acid annually, when operating at full capacity, will increasingly displace existing "sales" acid supplies in nearby consuming centres and possibly as far afield as in the London area.

Removal of Imported Brimstone Controls

As anticipated in earlier reviews of the *Quarterly Bulletin*, H.M. Government issued an order on 18th October terminating the individual licensing control of imports of elemental sulphur and its use in sulphuric acid manufacture. As from 1st January, 1956, sulphur may be imported without restriction from any country under Open General Licence and may be freely used for any purpose. It is not expected that the termination of controls will lead to an immediate major change in the supply pattern. Significant increases are probable at plants where restriction on the use of sulphur compelled the use of less economic alternative materials. Pending the natural growth of overall usage in the country, currently about 3%-4% per annum, anhydrite acid supplies should, however, displace some brimstone acid produced for sale, so that total sulphur usage will be little changed for some months to come. The reduction in spent oxide usage which has so far mainly occurred in the North-West, is likely to be halted near current levels of consumption, as the price of sulphur in this form is relatively low. Pyrites usage, however, due to the increasingly unfavourable cost relationship vis-a-vis other sulphurous raw materials is expected to lose ground progressively. The new supply pattern is likely to emerge in the latter half of next year when a high level of anhydrite acid supply and an increasing rate of elemental sulphur consumption are likely to be the outstanding features.

Current Events

UNITED KINGDOM

Possible Extension of Sulphur Recovery Facilities at Fawley

In view of the greatly increased use of fuel oil by British Industry oil refiners are faced with the decision either to increase refinery through-put or to reduce the use of heavy oil fractions in the production of high-grade petrol, by reforming low-grade petrol fractions arising in the course of normal refining operations in quantities in excess of demand. Esso Petroleum Company at their Fawley refinery have chosen the latter course and are at present building a hydroformer which will use low-octane petrol as feedstock to be converted to high-octane fuel in an atmosphere of hydrogen. This operation will result in a surplus of hydrogen being available which may be used in hydrofining and consideration is being given to using it for this purpose.

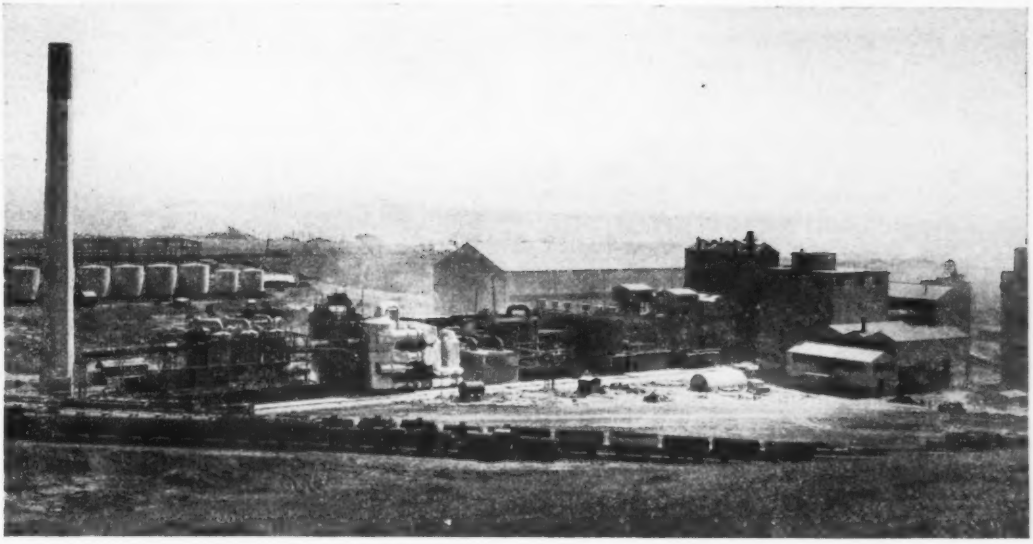
If, as seems probable, a hydrofining plant is built, this will lead to the arising of substantial quantities of hydrogen sulphide which would, in the same way as the current output, be converted into high purity elemental sulphur. Currently sulphur is recovered at a daily rate of about 50 tons which by the end of next year may thus be doubled.

New Anhydrite Acid Plant Changes Ownership

Under an agreement concluded early in November the entire share capital of Marchon Products Limited and the capital of the company's subsidiary Solway Chemicals Limited, not then held by Marchon, has been purchased by Albright & Wilson Limited for £2,617,500. It will be recalled that Solway's outside capital was held by the Industrial & Commercial Finance Corporation, H.M. Treasury having provided £2,350,000 towards the £3 million acid project.

The first unit of Solway's new anhydrite acid plant at Whitehaven* was started in July and with the completion of the second unit the company has available 100,000 tons (100% H_2SO_4) contact acid capacity. It is to dispose of about three-fifths of the acid output on the open market whilst two-fifths is required by the parent company, Marchon Products, in the manufacture of detergent intermediates, sulphonates, polyphosphates and phosphoric acid.

*—For details see Bulletin No. 7, p. 49.



General view of Whitehaven plant showing r. to l.: Rotary kiln and ground meal silo, gas cooling and cleaning installation, heat exchangers and converters.

The new association holds promise of strengthening both organisations and is expected to provide ample opportunities for the expansion of their joint interests. This is particularly the case since the extensive manufacturing activities of Albright & Wilson in the field of phosphoric acid and its derivatives are based on entirely different processes from those employed at Whitehaven and since the two companies interests in other fields do not overlap.

In announcing the acquisition, Albright & Wilson stated that the companies would continue to operate under their present managements. Mr. Frank Schön, chairman of both Marchon and Solway, is to be invited to serve on the board of Albright & Wilson.

Sulphur recovery by I.C.I.

The projected ammonia synthesis plant to be built by Imperial Chemical Industries Limited, Billingham Division, is designed to incorporate desulphurisation facilities in the purification train. The plant, which will substantially extend existing ammonia synthesis gas facilities, is being designed by I.C.I. engineers on the basis of information supplied by the Texaco Development Corporation and its features are novel in this country. Oil will be gasified under pressure of the order of 400 lbs. per square inch and ancillary installations will include an oxygen plant, carbon-monoxide converters, gas purifiers and compressors.

Desulphurisation of the gas stream will be effected, in conjunction with the removal of carbon-dioxide, by means of hot potassium carbonate washing which will result in the recovery of hydrogen sulphide, suitable for the manufacture of sulphuric acid or elemental sulphur. As this process accounts for not more than 80-85% of the hydrogen sulphide present, further purification is required which in this instance will be effected by a Gastechnik tower purifier using iron oxide in pelletised form. From the spent pellets sulphur will be recovered by a solvent extraction process and the clean pellets may then be re-used. The tower purifier will also absorb the hydrogen sulphide extracted by the wet process, so that practically the entire sulphur content of the gas stream will be recovered in elemental form at an anticipated rate of 1,000 tons per annum.

The Power Gas Corporation Limited, of Stockport, have been appointed by I.C.I. to act as main contractors; the oxide purifier is being supplied by Robert Dempster & Sons Limited, of Elland.

CANADA

Acid Plant Expansion

One of the oldest sulphuric acid manufacturers in Canada, the Nichols Chemical Company Limited of Montreal, recently announced important expansion plans.

The company's sulphuric acid plant at Valleyfield, Quebec, the capacity of which was doubled in 1952 to 100,000 short tons (100% H_2SO_4), is now to be expanded by a further 60%. The expansion is being achieved without the installation of additional roasting furnaces. During the earlier plant expansion excess capacity had been provided and modifications of the process are permitting more efficient utilisation. The additional acid output, which is to become available after February 1956, is intended to meet the rapidly growing industrial requirements in eastern Ontario and Quebec. Amongst these is Nichols Chemical Company's own new project at Thorold, Ontario, where the construction is about to start on a plant to produce liquid aluminium sulphate. Due to be in operation early in 1956, the plant will be the first in Canada to produce in liquid form this essential raw material for the pulp and paper industry. The lack of aluminium sulphate supply facilities in this area, one of the principal paper centres of Eastern Canada, enhances the importance of the new project.

The sulphur requirements of the company's Valleyfield sulphuric acid plant as well as of its other two plants at Sulphide, Ontario, and Barnet, B.C., are met in the form of pyrites.

Alaska Pine & Cellulose Limited

Following the purchase in mid-summer of 80% of the company's stock by Rayonier Inc., New York, the important U.S. rayon producer, projects involving an expenditure of $80 million have been announced. These include the construction of a new 100,000 tons per annum chemical cellulose plant and a $1 million installation at Marpole, Vancouver, to produce "Rayflo," an oil well mudding additive.

At present Alaska Pine & Cellulose Limited operate chemical cellulose plants at Woodpine, B.C., and Port Alice, Vancouver Island, B.C., and, consuming some 20,000 tons sulphur annually in these operations, they are one of the largest brimstone users in British Columbia. Besides the above mentioned new project the expansion of the Port Alice plant is also envisaged involving an expenditure of $6 million.

Trans-Canada Pipe Lines Limited

The earlier difficulties which had repeatedly postponed the start of construction work on the $350 million natural gas pipeline project from Alberta to Eastern Canada, now to extend over a distance of 2,340 miles, have largely been resolved with the assistance of the Federal Government. Following the personal intercession of the Prime Minister, Mr. St. Laurent, the Federal Government, in conjunction with the provincial Government of Ontario, decided to assume responsibility for the construction of the central section of some 220 miles across Northern Ontario which, due to the high cost of construction over the difficult terrain, had proved the stumbling block in the earlier financing plans. The 30" pipeline to be built at a cost of $118 million by the Ottawa-Ontario Crown Company will be leased to Trans-Canada Pipe Lines Limited, who will receive an option to buy the line any time within 10 years.

The eastern and western section of the pipeline are to be financed privately by the company whose task of attracting sufficient capital has been virtually resolved by the Federal Government's agreement to their entering into contracts with the Tennessee Gas Transmission Company of the U.S.A. These provide for the export of 200 million cubic feet daily into th U.S. Middle West by a branch line at a point near Emerson on the border of Manitoba and Minnesota. At the same time during the period of construction of the pipeline link, Eastern Canada is to receive U.S. supplies at the rate of 90 million cubic feet daily by a line entering Canada at Niagara to supply mainly the Toronto market. Once the link is established the gas flow is to be reversed and the U.S. north-eastern States are to be supplied with Alberta gas at a rate of 100 million cubic feet daily on an interruptable basis, dependent on Canadian requirements.

Approval by the U.S. Federal Power Commission for these supplies is pending, but no difficulties are expected from this quarter. Trans-Canada Pipe Lines Limited have already

placed an order for more than 200,000 tons of large high-pressure steel pipe with the U.S. Steel Corporation, at an estimated cost of over $30 million, for the western section of the pipeline which is due to be completed by the autumn of 1956. The link across Ontario is planned to be completed by late 1957.

It is expected that gas requirements will then lead to the arising of over 200,000 tons sulphur annually from sour gas cleaning operations in Alberta.

New Sulphur Recovery Project

Plans for the first major sulphur recovery project, to be built as the result of the anticipated natural gas requirements of the Trans-Canada Pipe Line, have been announced by the Canadian Gulf Oil Company.

Designed to treat daily 55 million cubic feet of sour gas from the company's Pincher Creek Gas field, the gas cleaning plant will extract liquid hydrocarbons, such as propanes, butanes and pentanes plus, and hydrogen sulphide which will lead to the recovery of 1,900 barrels condensate and 225 short tons elemental sulphur per day. Gas from Pincher Creek, one of Alberta's largest fields with reserves of two trillion cubic feet, has a sulphur content of 9¼% and the cleaning processes are essential to make it conform with the stringent quality requirements of gas suitable for long-distance transmission by pipeline and domestic and industrial usage.

The new cleaning and recovery plant, the second largest in the world, is being erected alongside the gas field some 50 miles south-west of Lethbridge, Alberta, and construction, which will start immediately, is due to be completed in September 1956.

Trans-Canada Pipe Lines Limited have signed a 25-year contract with Canadian Gulf Oil Company which provides for the daily supply of 100 million cubic feet of clean gas for the first year and 170 million cubic feet thereafter. Canadian Gulf Oil are reported to be making provision to return the initial output of processed gas to field storage should large-scale requisitions by the pipeline company suffer delay. A substantial part of the sulphur output has been contracted to Northwest Nitro Chemicals Limited, who intend to take delivery of sulphur in liquid state at their fertiliser plant at Medicine Hat which is at present under construction.

New Sulphuric Acid Plant

The major fertiliser plant project by Northwest Nitro Chemicals Limited which is being built at Medicine Hat, Alberta, at a cost of $22 million is due to be completed in September 1956.

With the exception of phosphate rock, which is to be obtained from nearby Montana, U.S.A., the raw material requirements for ammonium nitrate and ammonium phosphate production will be met from indigenous resources. Supplies of natural gas for ammonia synthesis will be drawn from the Etzikom Gas field 46 miles distant, the Alberta Petroleum and Natural Gas Conservation Board having granted a permit to Alberta Pipe Lines for the Construction of a 10″ pipeline.

The sulphur requirements of the sulphuric acid plant of about 44,000 tons per year will be obtained from Canadian Gulf Oil Company's new recovery plant at Pincher Creek. The production of ammonium phosphate is to be based on the St. Gobain/U.C.B. process — reacting phosphoric acid with ammonia — which is thus licensed in North America for the first time.

The company will manufacture annually 65,000 tons of ammonium phosphate 11-48-0, 42,000 tons of ammonium phosphate 16-20-0, and 35,000 tons of ammonium nitrate, 33.5% nitrogen. For the manufacture of these products they will produce approximately 128,700 tons of sulphuric acid.

Northwest Nitro Chemical Limited, who are a subsidiary company of Commercial Solvents Corporation of New York, have appointed as their selling agents for chemical fertilisers Messrs. Harrison & Crossfields of Toronto.

Developments at Shawinigan Falls

The Shawinigan Chemical Company Limited recently started construction of a $750,000 sulphuric acid plant at Shawinigan Falls, Quebec. Designed to produce 25,000 tons (100% H_2SO_4) annually, using brimstone as raw material, it is expected to come on stream in the latter half of 1956.

Simultaneously the du Pont Company of Canada have announced a $1 million expansion programme of their cellophane cellulose plant,

which will represent the third increase this year in productive capacity of packaging film.

INDIA

Sulphur and Sulphuric Acid

During the first half of this year imports of elemental sulphur totalled about 35,000 tons, 10% more than during the corresponding period of 1954. Sulphuric acid production of 77,800 tons was 3½% greater than the average rate of output in 1954. Non-acid uses during the first half-year, which do not fully reflect the greater requirements of the sugar refining industry, also increased largely on account of the 11% rise in viscose rayon manufacture. In this connection the start of operations in October of a new viscose rayon plant at Nagda, owned by the Gwalior Rayon & Silk Manufacturing Company Limited, is of interest. Its annual capacity of 5,300 tons staple fibre more than doubles existing production facilities.

New Sulphuric Acid Plant

Fertilisers & Chemicals (Travancore) Limited, of Alwaye, South India, the largest acid manufacturers in India, are planning a major expansion of their fertiliser and sulphuric acid production capacity involving a capital outlay of U.S. $6.3 million.

The new installations, for which tenders were invited early in October, are to include:—

Plant	*Rated capacity per day tons*	
Ammonia synthesis ...	40	
Ammonium sulphate ...	75	
Phosphoric acid	25	(30% P_2O_5)
Ammonium phosphate ...	50	(16/20 N-P mixture)
Ammoniated superphosphate ...	—	
Sulphuric acid	160	(100% H_2SO_4)

Sulphur-dioxide for acid manufacture is to be obtained from brimstone, and conversion is to be effected by the contact process. The company's existing sulphuric acid installation which started operating in 1951 consists of a contact plant with a rated capacity of 134 tons per day (100% H_2SO_4). When completed the new plant will more than double the company's brimstone requirements raising them to 34,000 tons per annum and making it by far the largest single brimstone user in India.

SOUTHERN RHODESIA

New Fertiliser Plant

Recently announced plans for the expansion of fertiliser manufacturing facilities in Southern Rhodesia by African Explosives and Chemical Industries (Rhodesia) Limited, include provision for the establishment of the first major sulphur using industry in this part of the British Commonwealth of Nations.

Hitherto the company, a joint subsidiary of I.C.I. and De Beers Consolidated Mines, had confined its operations to the production of mixed fertilisers on the basis of imported fertiliser materials. These facilities will now be expanded and modernised by the addition of a granulation plant. The main feature of the £3 million project is the construction of sulphuric and phosphoric acid plants permitting the manufacture of single and triple superphosphates. The initial capacity of these plants is reported to be sufficient to meet the needs of the Central African Federation for some years to come and to terminate its dependence on supplies hitherto imported from South Africa and overseas, notably the U.K.

The sulphur requirements of the sulphuric acid plant will be met in the form of indigenous pyrites. The only active producer, and probable supplier, is the Rhodesia Broken Hill Development Company. Their Iron Duke Mine near Glendale is 58 miles distant by rail from the projected plant at Rhodia Factory, Salisbury. At present the mine produces about 40,000 tons pyrites annually, the bulk of which is exported to the Union of South Africa since domestic needs had in recent years been limited to its use as flux in copper smelting operations. Plans exist for the expansion of operations to a rate of 24,000 tons pyrites per month.

UNION OF SOUTH AFRICA

Modified Uranium Acid Plant Project

At the recent Annual General Meeting of the Blyvooruitzicht Gold Mining Company, one of the seven companies* authorised to engage in sulphuric acid manufacture for uranium oxide recovery from gold ore tailings, the Chairman, Mr. W. M. Frames, announced a significant change in the execution of the company's sulphuric acid project. Originally it had been planned to meet the sulphur requirements of the new acid plant in the form of imported brimstone, the only plant engaged in uranium oxide recovery to be supplied with

*—See Bulletin No. 6, p. 5.

sulphur in this form. On the recommendation of the company's technical advisers it was, however, decided to install instead roasting facilities using by-product pyrites concentrates, in line with other acid makers serving the uranium industry. The cost of the pyrites plant is estimated at £¾ million, 75% more than the scheduled cost of the brimstone acid project.

The company's uranium plant has been operating at full capacity throughout the past year using bought-in acid. In view of the increasing rate of activity in this new sector of industry, which was scheduled to require about half-million tons acid by the end of this year, the start of operations of the company's new acid plant is becoming a matter of urgency. The higher capital requirement of the amended project is expected to be compensated by lower operating expenses, since the cost of recovery of pyrites from gold slimes compares favourably with that of imported brimstone.

Fertiliser Plant Project

Fisons Limited are considering a plan to build a £3.5 million fertiliser factory at Sasolburg, about 50 miles south of Johannesburg. Production of 150,000-300,000 tons mixed fertiliser and 100,000-200,000 tons superphosphate is envisaged and the plant may include production facilities for sulphuric acid. Ammonium sulphate requirements would be met by supplies from the adjacent plant of the South African Coal, Oil and Gas Corporation Limited (SASOL), where it arises as a by-product in the course of oil from coal operations. Phosphate rock may be obtained from the Phosphate Development Corporation (Pty.) Limited (Foskor), the new producer in N. Transvaal.

The erection of a fertiliser plant in the heart of the Union would be a departure from tradition, as in the past, due to the need to import phosphate rock supplies, fertiliser plants were sited at seaports.

UNITED STATES

New Sulphur Recovery Plant

Construction work is to start immediately on a second hydrogen sulphide extraction and sulphur recovery unit at the Santa Maria, California, oil refinery of the Union Oil Company of California. The present plant which started operating in December, 1952, has a capacity of 22,700 tons elemental sulphur. The new unit, which is being built primarily to contribute to the abatement of air pollution, is reported to be projected as a duplicate of the existing plant.

Off-shore Sulphur

The first stage of the development work on the submerged sulphur dome of the Humble Oil & Refining Co. in Block 16, situated six miles off the Louisiana shore at Grand Isle, is on the point of completion.

In the course of a two-year intensive coring programme accurate results of the dome's potentialities were obtained which are at present being evaluated with a view to deciding whether the economic and engineering aspects of the project will warrant the exploitation of the dome.

Several miles to the west of this dome, in Block 18, another sulphur deposit has been discovered by the company and coring is at present in progress. Results so far are not yet sufficient to determine whether or not this dome deposit also holds promise of commercial exploitation

New Sulphuric Acid Plant

In October the Grasselli Division of E.I. du Pont de Nemours announced plans for the construction of a new sulphuric acid plant on a recently acquired site near the confluence of the Ohio and Greater Miami rivers, some 20 miles downstream from Cincinnati.

The new plant, to be known as Fort Hill works, is intended to replace an existing plant at Lockland, near Cincinnati, which will close down when Fort Hill starts operating in the latter part of 1956. Construction of the new plant, which has already started, is being carried out by the Leonard Construction Company of Chicago. Its capacity has not yet been announced but it is understood that it will be based on the use of brimstone in conventional solid form.

FRANCE

New Sulphuric Acid Plant

The sulphuric acid requirements of the Société des Produits du Titane, who are building a new titanium pigments factory at Le Havre, are to be met by the Cie St. Gobain. The new acid plant, to be erected in the vicinity of the titanium works, is expected to be based on the use of brimstone.

ITALY

New Sulphur Ore Treatment Plant

Exploitation has started of the sulphur ore deposit of Manziana near Viterbo in Central Italy, about 50 km. north of Rome. Earlier this year its extent was determined and estimated at 26 million cubic metres of sulphur bearing minerals—in the form of sedimentary sulphur ores and metal sulphides notably marcasite—containing about 20% sulphur. A flotation plant with a daily capacity of 80 metric tons crude ore is at present being installed and it is intended to produce a sulphur concentrate containing about 50% sulphur suitable for use in sulphuric acid manufacture. Commercial operations, in which Montecatini are reported to have an interest, are due to start in February, 1956.

POLAND

Pyrites Production

Production facilities at one of Poland's largest pyrites mines, Bialy Kamien, which at present yields annually about 21,000-23,000 tons pyrites, are being expanded. The ore is 99.7% pyrite, containing about 46% sulphur. To meet the acid industry's pyrites requirement of over 200,000 tons per annum domestic supplies have to be supplemented increasingly by imports. It is estimated that in 1955 about 60,000 tons pyrites will have been purchased from Scandinavia, Roumania and Bulgaria. In view of the progressive exhaustion of Poland's pyrites resources the development at Bialy Kamien is not likely to do more than maintain the present level of domestic pyrites supplies.

New Sulphur Deposits

Since the discovery early in 1953 of the occurrence of sulphur ore in the Sandomierz region in Southern Poland, intensive exploration under the direction of Professor Stanislav Pavlovski is reported to have led to the discovery of major deposits of commercial importance. The largest, stated to have reserves in excess of 50 million tons sulphur ore, is situated in Rzeszow district near the southern boundary of the Sandomierz depression. It is believed to have been under active development since last year and is projected to yield annually a sufficient tonnage to permit the production of 200,000 tons refined sulphur.

In June of this year sulphur finds were reported from Szydlowo in the Busko District, where there are also extensive anhydrite deposits. The latest discovery, announced by the Polish authorities in October, is near Tarnobrzeg, in the north-eastern part of the Sandomierz depression. It appears that this deposit is to be worked by opencast methods, an overburden of 15 million metres of earth having had to be removed. No details of the type of refining plant stated to be under construction are as yet available.

Elemental sulphur requirements of the Polish industry are moderate—believed to be about 20,000 tons annually — as the entire requirements of the sulphuric acid industry are at present met in the form of sulphur in pyrites, smelter gases and anhydrite.

The Polish Government has indicated that it intends to place the surplus tonnage of sulphur in export markets, notably Great Britain, Germany and France. In view of the substantial requirements of the U.S.S.R. it is, however, not thought probable that significant tonnages may become available in the near future. Furthermore, the availability of domestic brimstone supplies may lead to part of Poland's growing acid requirements being met from this raw material, particularly as sulphur supplies both in smelter gases and pyrites are declining. The possibility of domestic brimstone supplanting imported pyrites, a decision which would accord with the Government's plans for self-sufficiency, cannot be excluded.

SPAIN

New Sulphuric Acid Plant

The Spanish Government has recently authorised the Union Española de Esplosivos, S.A., to carry out a major expansion project of the Company's sulphuric acid and superphospate production facilities at Seville. At present the San Jerónimo works are equipped with a chamber plant with a capacity of 8,640 tons acid (100% H_2SO_4) which in 1954, working at 82% capacity, produced 10,571 tons 53° Bé Acid. The projected new acid plant will consist of two furnaces, with a daily capacity of 50 tons pyrites each, which will permit the production of 105 tons contact acid per day (100% H_2SO_4).

The new superphosphate plant, designed to produce 120,000 tons per annum, is to consist of two sections, which will include phosphate

grinding facilities with a joint capacity of 16 tons per hour.

Most of the plant is to be built in Spain, and the total cost, including imported parts, is estimated at £2.9 million.

Union Española de Esplosivos, S.A., is the second largest superphosphate manufacturer in Spain, operating ten acid/fertiliser plants. The Company has plans for one further project with an annual capacity of 36,500 tons acid, which awaits authorisation.

ECUADOR

Ecuadorian Mining Corporation

Early in October it was announced that the von Kohorn interests have disposed of all investments in Chemical Plants Corporation and Ecuadorian Mining Corporation and that all members of the von Kohorn family have ceased to be officers, directors or shareholders.

The controlling interest in these two companies has been acquired by New York Securities Corporation, of 521 Fifth Avenue, N.Y. The Corporation's president, Mr. R. D. Jonap, stated that the policies followed by the former management would remain unchanged.

The mines and sulphur refining installations at Tixan, Ecuador, are at present working at full capacity to execute substantial orders, some on a long-term basis, from other South American countries. Earlier this year a new ore flotation plant was put into operation which led to increased output. Plans for the expansion of mining and refining facilities are in hand and it is expected that this year's anticipated output of 15,000 tons refined sulphur will be substantially exceeded in 1956.

BURMA

New Sulphuric Acid Plant

Construction of a 10-ton per day (100% H_2SO_4) acid plant is to start shortly under joint enterprise between private Burmese capital and the Government. It is to be based on the use of elemental sulphur and will convert the sulphur dioxide by vanadium catalyst. Its probable location is reported to be near Rangoon and its output will meet, principally, acid requirements for accumulators and oil refining.

At present there is only one acid plant in existence which, situated in Rangoon, produces one ton contact acid per day from imported Japanese sulphur.

INDONESIA

New Sulphur Production

According to a local Government report from the province of Kedu in Central Java, the exploitation of the sulphur deposits on the Dieng Plateau is to be resumed. It is estimated that these volcanic deposits contain at least 150,000 tons sulphur.

The NV Abimanju Trading Company of Djakarta has started the construction of a Rupees 1 million sulphur refining plant designed to produce initially about 10 tons refined sulphur per day.

In recent years Indonesia has been importing practically the entire requirements of the country, as apart from intermittent sulphur mining by local inhabitants no organised mining or refining operations have been carried out since before the Japanese invasion, when total sulphur output at Dutch controlled mines reached about 18,000 tons annually. Over the past five years average imports amounted to about 6,300 tons, mostly of U.S.A. origin.

JAPAN

Sulphuric Acid*

During the first nine months of this year production of sulphuric acid totalled 2,443,700 tons (100% H_2SO_4) which, representing an annual rate of over 3¼ million tons, was 7¾% more than output during the corresponding period of 1954.

The distribution of acid output based on various raw materials was as follows :—

	Jan.-Sept. 1955	*Jan.-Sept. 1954*
Iron pyrites, sulphur ores, spent oxide and brimstone	88.5%	89.1%
Copper pyrites & concentrates	6.2%	6.1%
Zinc blende	5.3%	4.8%
Total sulphur used ...	865,000 tons	806,000 tons

The use of elemental sulphur in acid manufacture has receded further and currently appears to be less than 2,100 tons annually.

Sulphuric acid consumption totalled 2,451,900 tons, 7% more than during the corresponding nine months of 1954. The largest relative increase—19%—was in the use of acid in artificial fibre manufacture. Use in fertiliser manufacture continued to account for a large proportion of total consumption, although this year the greater use by other industries, reduced its share from 73½% to 72¼%.

* For further details see Statistical Appendix.

Statistical Appendix

Mexico

SULPHUR PRODUCTION (metric tons)

	Rock	Recovered	Frasch	Total
1947 ...	3,200	—	—	3,200
1948 ...	2,500	—	—	2,500
1949 ...	5,400	—	—	5,400
1950 ...	11,200	—	—	11,200
1951 ...	10,544	18,211	—	28,755
1952 ...	11,974	36,530	—	48,504
1953 ...	12,188	40,116	—	52,304
1954 ...	6,000	20,238	76,636	102,874

SULPHUR EXPORTS—January to September, 1955

	Pan American	Mexican Gulf	Total
		Tons	
U.K.	16,164	3,554	19,718
Australia ...	9,296	10,616	19,912
India	—	4,471	4,471
South Africa ...	8,197	—	8,197
U.S.A. ...	20,620	3,764	24,384
Brazil	1,649	—	1,649
Belgium ...	5,081	—	5,081
France ...	7,322	—	7,322
Germany ...	—	17,984	17,984
Sweden ...	5,976	—	5,976
Israel	—	4,064	4,064
	74,305	44,453	118,758

Japan—Sulphuric Acid Manufacture

SULPHURIC ACID PRODUCTION

(thousand metric tons 100% H_2SO_4)

Acid produced from	*Jan.-Sept. 1955* Chamber	Contact	Total	*Jan.-Sept. 1954* Chamber	Contact	Total
Zinc Smelter Gases	38.8	90.8	129.6	27.1	82.0	109.1
Copper Smelter Gases ...	102.1	49.4	151.5	94.3	43.9	138.2
Sulphur Ores*	917.0	1,245.6	2,162.6	872.5	1,145.2	2,017.7
	1,057.9	1,385.8	2,443.7	993.9	1,271.1	2,265.0

* Including Domestic and imported Iron pyrites and pyrrhotite, sulphur ores, elemental sulphur and spent oxide.

SULPHURIC ACID CONSUMPTION

(thousand metric tons 100% H_2SO_4)

	Jan.-Sept. 1955	*Jan.-Sept. 1954*	*Change %*
Nitrogenous Fertilisers	1,200.5	1,179.3	+ 2
Phosphoric Fertilisers	567.9	505.1	+12½
Artificial & Synthetic Fibres	273.4	229.6	+19
Inorganic Chemicals	93.3	81.0	+15¼
Dyes & Intermediates	68.9	64.5	+ 6¾
Iron & Steel	35.9	38.9	− 7½
Petroleum	34.4	31.4	+ 9¾
Metal Industry	21.6	25.0	−13½
Organic Synthesis	13.0	†	*
Metallurgy	11.3	11.0	+ 2¾
Paper & Pulp	10.3	†	*
Explosives	10.2	†	*
Other Uses	111.2	128.4	*
	2451.9	1,194.2	+7%

† Included under other uses
* Not comparable

CONSUMPTION OF SULPHUROUS RAW MATERIALS

(thousand metric tons)

	Jan.-Sept. 1955	*Jan.-Sept. 1954*	*Change %*
Iron Pyrites	1,220.7	1,782.2	+ 5¼
Pyrrhotite	125.2		
Sulphur Ore	528.4		
Zinc Blende	150.4	131.5	+14½
Copper Concentrate	56.6	45.7	+25¼
Copper Pyrites	52.6	51.8	+ 1½
Imported Pyrites	2.0	5.3	−61½
Spent Oxide & Elemental Sulphur ...	3.3	7.7	−56½

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